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Rubber Research Institute of Ceylon

Combined 3rd & 4th Quarterly Circulars for 1951

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Rubber Research Institute of Ceylon

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CONTENTS

ERRATUM.

Advisory Circular No. 21.

The title and first sub-title of this Circular should read as follows:

THE CONTROL OF BARK ROT AND CANKER

Bark Rot.—This disease of the tapping panel is known under..

NOTICES

DARTONFIELD ESTATE — VISITORS' DAY

THE services of technical officers are available to visitors on the second Wednesday in each month ; the estate superintendent is available every Wednesday. Visitors are requested to arrive on the estate not later than 9.30 a.m.

Visitors will be welcomed at the station on other days provided an appointment has been made in advance.

Dartonfield Estate is situated about 3½ miles from the main Matugama-Agalawatta Road, the turn-off being near culvert No. 14/10. The distance from Colombo is approximately 47 miles.

PUBLICATIONS

Rubber Research Institute publications comprising Annual Reports, Quarterly Circulars and occasional Bulletins and Advisory Circulars are available without charge to the Proprietors (resident in Ceylon), Superintendents and Local Agents of rubber estates in Ceylon over 10 acres in extent. Forms of application for registration may be obtained from the Director. Extra copies of publications can be supplied to the Superintendents of large estates for the use of their assistants.

It will be appreciated if subscribers will return any back publications which are of no use to them.

ADVISORY CIRCULARS

The undernoted Circulars may be obtained on application at 25 cents per copy. Future issues in the series will be sent free of charge to estates registered for the receipt of our publications :—

- (1) Notes on Budgrafting Procedure (Revised May 1952).
- (4) Contour lining, holing and filling, cutting of platforms, trenches and drains (Revised June 1943).
- (5) Straining box for latex (January 1940).
- (6) Notes on the care of Budded Trees of Clone Tjirandji 1 with special reference to Wind Damage (Sept. 1938).
- (8) Planting and after-care of budded stumps and stumped buddings. (Revised June 1943).
- (12) Warm Air Drying House for Crepe Rubber (Reprinted 1952).
- (14) Rat Control (September 1940).
- (17) Tapping Young Budded Trees — Prevention of Precoagulation (2nd Supplement) (Revised March, 1949).
- (19) Density of Planting and Thinning out (December 1942).
- (20) Recommended Planting Material (Revised May 1944) and supplement.
- (21) The Control of Bark Rot and Canker (Revised February 1952).
- (23) Uniformity in the Nomenclature of Clones & Clonal Seedlings (December 1944).
- (24) Treatment of Brown Bast (December 1944).
- (25) Ground Covers (January 1945).
- (26) Clonal Seed as Planting Material (July 1947).
- (27) Collection and Planting of Clonal Seed (April 1949).
- (28) Oidium Leaf Disease (November 1950) (superseding Circular No. 22).
- (30) Fertilisers for Rubber (Aug. 1951) (superseding Circulars No. 2, 18 & 29).
- (31) Root Disease in Replanted Areas (October 1951) (superseding Circular No. 10).
- (32) Crown budding for Oidium Resistance (October 1951).
- (33) Mechanical Felling of Rubber Trees (February 1952).
- (34) Tapping Systems (February 1952) (superseding Circular No. 17).
- (35) Notes on Rubber Seedling Nurseries (February 1952) (superseding Circular No. 3).

NOTES ON THE INTRODUCTION OF HEVEA TO CEYLON

By

H. E. YOUNG, D.Sc., Agr. (Queensland)
Director

Introduction

MANY questions have been asked and arguments heard concerning the early history of rubber planting and it is thought that a brief sketch of the subject giving the salient points might now be opportune. Most of the information is taken from the record published by Petch (1914) who made a comprehensive survey of the subject up to year 1904 obtaining his material from the extensive original documents then available to him in Ceylon and England.

The Importation of South American Rubber Trees

The successful introduction of Cinchona to India led Sir Clements Markham in 1870 to consider that this might also be accomplished in the case of rubber producing plants as owing to the increasing consumption of rubber and the destruction of the naturally occurring rubber trees by native tapping methods it was thought that the supply would shortly fail to meet the demand.

The Indian Government was persuaded to take steps to alleviate the position by introducing new rubber yielding plants or by establishing controlled plantation of *Ficus elastica*. Markham who was attached to the India office commissioned Mr. J. Collins to collect all available information concerning rubber trees. Collins had been curator of the museum of the Pharmaceutical Society and not a plant collector and there is no evidence that he visited South America.

Collins' report (1872) was compiled from information previously published and his information in regard to Hevea was derived from Spruce whose notes were published by Bentham (1854). The report includes a recommendation by Dr. Brandis approving the suggestion to import Hevea in which regard Brandis wrote " The nearest approach to this (*i.e.* the rainfall of Para) would be found in some parts of Ceylon, which, as regards temperature also would appear to offer to the Brazilian Heveas a most congenial climate." He also suggested Malabar and Burma.

Resulting from Collins' report it was concluded by Markham that plantations of *Ficus elastica* should be established in Assam but that the caoutchouc from the Heveas and Castilloas of South America was better than that of Ficus and that these former trees should be introduced to British India.

In Ceylon experiments with *Ficus elastica* were not very successful in the seventies.

The first Introduction of Hevea

Attempts were made by the India Office to import seeds of Hevea and the British Consul at Para was instructed to obtain supplies. Before the first consignment of seeds arrived the Royal Botanic Gardens at Kew under Sir Joseph Hooker came into the picture and it is to the support and energy of Hooker that the ultimate success of the project was due.

The first seeds were obtained in June 1873 when on June 4th Markham forwarded 2,000 seeds to Kew for which the India Office paid £5. They were obtained from a Mr. Farris who brought them from Cameta. About a dozen plants were raised from these seeds and in the same year Dr. King of the Royal Botanic Gardens at Calcutta took six of these plants with him on his return to India. From these six others were raised by cuttings and distributed to Sikkim. The climate of Calcutta proved unsuitable to Hevea and in 1876 King reported that Hevea had failed in Calcutta and Sikkim.

A second consignment of seed sent to India in 1875 was even less successful not a plant being obtained. The seed was packed in large barrels.

Second Introduction of Hevea

When the sending of seed in the ordinary way was proved unsuccessful Markham engaged Mr. Robert Cross who helped him to import Cinchona to proceed to South America to obtain plants. Cross however was sent first to Central America for seeds and plants of Castilloa.

In the meantime Sir Joseph Hooker commissioned Mr. H. A. Wickham who was then residing at Santarem on the Amazon to collect seeds at the rate of £10 per thousand. Wickham had been engaged in rubber tapping on the Orinoco in 1869—70 and had published in 1872 an account of a journey to the Amazon *via* the Orinoco. His account showed that he was acquainted with the trees in question and caused Sir Joseph Hooker to select him for the contract.

Wickham collected his seeds (about 70,000) from trees which were being tapped "in the forests covering the broad plateaux dividing the Tapajos from the Madeira rivers." They were shipped immediately on the s.s. Amazon which happened to be about to leave for England when the seeds were ripe. Wickham accompanied the seeds to England where he arrived on June 14th 1876. The seeds were sown on the following day and 2,700 germinated some as early as four days after sowing.

Ceylon was chosen in accordance with Dr. Brandis' recommendation as the centre where the plants should be established so they might be distributed to different parts of India. In August 1876 1,919 plants were forwarded to Ceylon in 38 Wardian cases on the s.s. Duke of Devonshire in charge of a gardener and about 90 per cent. arrived in good condition. 100 plants were sent in a further consignment in 1877 making 2,019 plants in all.

In addition to this consignment two cases were sent to Singapore and small parcels to Africa (West Coast), Burma, Dominica, Jamaica, Java, Queensland (Australia) and Trinidad.

All the plants sent to Burma died, but a second case was sent later in the year to Calcutta where the plants were distributed to Assam and Burma (Mergui).

In a later Brazilian publication it was stated that Wickham obtained his seeds with the good offices of the Brazilian Government who arranged for Indians to collect them from the ground in the lower Tapajoz. It is possible that the authors of this were confusing the 1876 collection with the attempts in 1873 to obtain seeds through British Consuls in Brazil.

In all it would appear that between 1800 and 1900 living plants were established in Ceylon allowing for deaths.

Third Introduction of Hevea

In 1876 Cross after collecting Castilloa seed in Panama went to Brazil to procure Hevea braziliensis. He left England within a week after Wickham's arrival. He began in August to collect seedlings around Para and sent over 1,000 plants to England packed in cases with leaf mould and wood ashes. He returned to England in November, 1876. The distribution of Wickham's plants had then been completed. Of Cross's 1,080 seedlings 680 were handed over to Bull a commercial nurseryman of Chelsea and the remainder kept at Kew. In each case about 3 per cent. were saved. From these, plants were propagated by cuttings approximately 100 being subsequently sent to Ceylon (September, 1877) and small parcels to Singapore, Java, Queensland and Mauritius. Twenty-two plants went to Singapore and it was probably nine of these which Murton planted in Perak in October, 1877.

The total cost of the introduction of Hevea is stated to have been £1,505-4-2. including payment to Wickham and the expenses of Cross.

Details are :

Wardian cases	..	..	£120
Carriage to docks	..	..	7
Kew Expenses	..	..	10
Freight to Ceylon, etc.	..	..	163
Wickham (payment)	..	..	700
Cross (expenses)	..	..	505

Other Introductions of Hevea brasiliensis

There are several records which indicate that other introductions were made from time to time of which little is known. As an example in 1881 Mr. Scott Blacklaw advertised for sale seeds of Ceara and Hevea from Brazil in the Ceylon Press.

Source of Seeds

From the above it will be seen that in addition to the seed obtained by Wickham from the Tapajos area, there were plants originating from Para and sent by Cross and the first seed obtained from Cameta near Para.

Subsequent History

By the end of 1877 Hevea had been established at Peradeniya and Heneratgoda, at Singapore, at Kuala Kangsar in Perak and at Mergui in Burma. The fate of the consignment to countries outside Asia does not concern us here.

The trees first flowered in 1880 and ripe seed was obtained for the first time in 1881 in both Perak and Ceylon.

Distribution in Ceylon

The plants received from Kew were kept in bamboo pots at Peradeniya until the following June when Heneratgoda was ready to receive them. Some were kept at Peradeniya and planted there.

A number of the original plants from Heneratgoda were distributed to estates and some hundreds were left in a plantation at Heneratgoda. This plantation was planted far too densely and the smaller plants were later dug out and either distributed or placed in a second plantation at Heneratgoda.

Both the Heneratgoda plantations and some of the original trees planted at Peradeniya still survive. In addition there are original trees on some of the older estates.

The seedlings established from Cross's original collection are at present unidentifiable.

After flowering and fruiting commenced in both Malaysia and Ceylon a regular interchange of seed supplies took place and for some years large quantities of seed were exported from Ceylon from the government gardens and from estates.

General

From the above notes it would appear that we have to thank Sir Joseph Hooker and Sir Clements Markham for the introduction of this crop to Ceylon.

It would also appear that a fair selection of high grown types of Hevea as collected by Wickham and low grown as collected by Cross form the ancestry of our present plantation trees in the main. Of the origin and success of the commercial direct importations of seed from Brazil of which there is some evidence nothing is now known.

YIELDS OF BUDDED RUBBER AND CLONAL SEEDLINGS IN COMMERCIAL TAPPING

By

C. A. DE SILVA, B.Sc., Agric. (Lond.), Botanist

YIELDS of budded and seedling rubber in commercial tapping are presented in this paper up to end of 1950. Previous articles on the present series will be found in the following publications :—

(1) Combined Third and Fourth Quarterly Circulars for 1945, Vol. 22, Parts 3—4, p. 10.

(2) Combined First and Second Quarterly Circulars for 1947, Vol. 24, Parts 1—2, p. 3.

(3) Combined Quarterly Circulars for 1948, Vol. 25, Parts 1—4, p. 10.

(4) Combined Quarterly Circulars for 1949, Vol. 26, Parts 1—4, p. 26.

The eighth questionnaire sent out to estates early in 1951, brought in yield results from approximately 15,900 acres.

As in previous years a substantial part of the yield returns representing the older clones, which are of no more interest, has been discarded. The comparative data presented in the tables are restricted mostly to clones and seedling material, which are of interest for future replanting and new planting in Ceylon. Owing to the difficulty of obtaining yield results of individual clones under estate tapping conditions a number of estates have sent in results from mixed clone areas. These reults are of considerable interest and have been summarised in Table IV. Yield results presented according to districts in the last article in 1949 have been eliminated, owing to the difficulty of obtaining representative acreages for each district for a comparison of any practical value.

Apart from the hereditary characteristics of any particular clone for high yields, there are a number of outside factors, which contribute to some variability in yields. When yields are presented on an acre basis, variations

in stand of tappable trees and the number of tappings under a particular tapping system contribute to the difficulties of comparing the yields of clones and clonal seedlings within estates, between estates and from district to district. Yields expressed in pounds per tree per tapping year in Tables II, IV and V give a closer comparison of the yielding capacity of clones, irrespective of the stand per acre. This can only partially eliminate the latter disturbing factor as a low stand per acre has more space for development than a high one especially after the first three to four years of tapping.

In all records the tapping intensity is 100%, unless otherwise stated with asterisks. Areas under 5 acres are not generally taken into the records of this publication, except for the newer clones which have been planted on limited acreages for purposes of trial. It has been possible to present in Table III the yields of local clones and new foreign clones, which will come in for consideration for large scale planting in the near future.

Small scale trials of new planting material in the Institute's experimental plantations will not give the final information for general recommendation. The confidence for making a final choice for large scale planting can only be gained by comparing the results obtained at the Rubber Research Institute with those obtained in small scale trials on estates in the various planting districts in Ceylon.

Table I is restricted to the older clones TJ. 1, TJ. 16, BD. 5 and BD. 10. Clone TJ. 1 is treated as a control and yields of the other clones are given in pounds per acre and as a percentage of clone TJ. 1.

Clone TJ. 1.—This clone still represents the largest budded rubber acreage in the yield returns from estates. In the collation of these results yields up to the fifth year of tapping are represented by over 4,000 acres, with an average yield of 750 lbs. per acre per year. Yields up to the eleventh year of tapping on smaller acreages give an average yield of over 800 lbs. per acre per year. The inclusion of this clone for large scale planting is still fully justified although it has a few undesirable secondary characters. The main objection at the present time is due to the latex colour for production of sole-crepe rubber. There is evidence, however, that the colouration is due more to enzymatci discolouration than to the presence of a pigment in this particular clone, and very satisfactory sole-crepe has been produced in certain districts. There is also the possibility of a satisfactory discolouring agent being developed in the near future. Clone TJ. 1 is still included in our list of clones for large scale planting with the proviso that it should not be planted in very exposed areas.

Clone TJ. 16.—The yields of this clone are still satisfactory, but are not up to the standard of clone TJ. 1 in the wet low country districts. It has done well in the Kurunegala and Matale districts, and is recommended for large scale planting in the drier rubber growing districts of Ceylon. Compared with clone TJ. 1 the latex colour is decidedly white and appears to make a very desirable type of sole-crepe.

Clone BD. 5.—This clone was not recommended for large scale planting because of its susceptibility to Phytophthora diseases on bark and stems. There is little doubt, however, that the clone in spite of these defects has made a substantial contribution to the high average yields of budded rubber on many estates. The clone thrives on deep soils, especially along river banks, and its yields compare very favourably with those of clone TJ. 1. On two estates No.'s 166 and 26 in Table I the clone has yielded over 1,500 pounds dry rubber per acre in 1950.

Clone BD. 10.—This clone was also taken off from our list for large scale planting on early observations. Results from about fifty acres presented in Table I are, however, very satisfactory and compare favourably with those of clone TJ. 1. At the present time there are new high yielding clones, which can be more confidently recommended on secondary characters.

Table II has been prepared for comparing the yields of clones Glenshiel 1 and PB. 86 with clones TJ. 1 and TJ. 16 where possible.

Clone Glenshiel 1.—This clone again shows excellent yields compared with clone TJ. 1. In many instances the clone shows the highest yields on a per tree basis compared with clones TJ. 1 and PB. 86. Owing to the lack of stability of its latex for certain purposes the clone has been excluded from planting programmes in recent years. A stabilising process has been found, however, which improves the quality of the latex and it is possible that with further research the objection to this clone will be removed. The clone is particularly useful for exposed areas.

Prang Besar 86.—The results of this clone in our studies of yields on estates in the various districts are confined to smaller acreages than those for clone TJ. 1. In considering yields together with other secondary characters there is little doubt that clone PB. 86 is the best for large scale planting at the present time. On estates where previous experience has shown that the yields and secondary characters are up to expected standards, the inclusion of this clone for planting up to 50 per cent. of the total acreage replanted is justifiable. The writer is aware that in certain instances Clone PB. 86 has been used on the total replanted area of a considerable size on the grounds that it is advantageous both for consistent high yields and control of disease. The writer would like to comment that there is always an element of risk in only having a single clone to rely on especially in cases where a disease may not have a 100 per cent. efficient control measure available for adoption. It is well known that clonal characteristics show varying degrees of immunity and susceptibility to both bark and leaf diseases.

There is also the necessity of co-operation from estates for small scale trials of new high yielding clones, which do not enjoy the reputation of a clone like PB. 86, merely because estates have delayed to plant these out.

Clones MK. 3/2, WG. 6278, HC. 55, HC. 28, AV. 352, AV. 255, PR. 107, LCB. 1320.—The yields of these clones are included in Table III. It is evident that the adoption of a high initial stand according to our recommendations in recent years has resulted in high yields during the early years of tapping, except in the case of clones which girth quickly like clone HC. 28, where the early yields are quite high even with a low stand. The danger here is the loss of trees which brings the stand to an uneconomic level, just when the clone is able to give peak yields.

Clone MK. 3/2.—This local clone has been recommended for the wet low country districts. Its inclusion in our list for large scale planting has been fully justified. It gives a very desirable white latex, and has turned out to be a reliable clonal seed parent. It is rather susceptible to bark diseases, especially canker of the tapped bark. The correct concentration of disinfectant applied during the wet weather period is, however, an effective preventive. This clone has been recommended for commercial planting on a small scale in Indonesia in 1951, on results of experimental trials.

Clone HC. 28.—This clone is a quick grower and is capable of giving very high yields. Owing to a fluted stem, (which is really not a great deterrent to good tapping), and its very yellow latex this clone does not appear in our list for large scale planting. With the success of recent methods in decolourising the yellow pigmentation of latex, it is possible that the clone may be considered again for large scale planting.

Clone HC. 55.—This clone was dropped from our list for commercial planting mainly because of the mixing of two clones under the same nomenclature on the estate of origin. In recent correspondence with Indonesia there are indications that the correct HC. 55 clone has given very promising yields in experimental plantations. The rather limited results presented in Table II show that the clone is capable of giving 1,000 lbs. dry rubber per acre. The latex is white.

WG. 6278.—This clone is on our list for large scale commercial planting in the wet low country districts. The results presented come from a limited acreage. The indications are that with a correct stand of tappable trees per acre the clone is capable of giving very high yields. The latex is decidedly white and the clone is comparatively free of bark diseases compared with clone MK. 3/2. WG. 6278 is also recommended for commercial planting on a small scale in Indonesia in 1951.

Clones AV. 255 and PR. 107.—Both these clones have a reputation for high yields and are on the list for large scale commercial planting in Indonesia in 1951. The rather limited results in Table III and experimental results at Dartonfield indicate that both clones are capable of reproducing their high yielding characteristics in this country. The latex of both clones is white, and can produce very good sole-crepe. Clone PR. 107 is somewhat resistant to Oidium leaf disease. The writer has had very good reports of these clones from many estates, but unfortunately these results are not available for publication in this article.

Clone LCB. 1320.—This clone has been known in this country under the pseudonym " CHM. 2 ", since 1938. Unfortunately owing to a controversy arising from the importation of this clone into this country, the Rubber Research Institute was unable to introduce it for trial until 1946. There is little doubt that the clone is high yielding and it appears on the list for large scale commercial planting in Indonesia for 1951. The writer was given an opportunity of investigating the performance of this clone on two estates in Ceylon in 1951. The yield results are given under :—

Yields of Clone LCB. 1320

Estate	Year of planting	Acreage	First tapped	Trees per acre in tapping			Yield per acre, lbs. dry rubber		
				1949	1950	1951	1949	1950	1951
A	38/39	9	Nov. 1946	131	131	138	733	732	901
	39/40	25	May 1947	97	107	106	399	397	472
	40/41	36	May 1947	99	110	111	308	556	565
B	1940	12	Mar. 1949	70	73	—	337	527	—
	1940	13	,,	83	85	—	334	636	—

Considering the fact that this clone has been somewhat overadvertised in this country, outside the Rubber Research Institute, the available yield figures are rather limited. However, the above results are satisfactory, when the yields are assessed on the number of tappable trees per acre. A tapping task of 300 trees on estate A on the alternate day half spiral tapping system on rather difficult terrain acted as a deterrent to good tapping for maximum results. Clone LCB. 1320 is recommended for trial on a small scale on commercial plantations.

Mixed Clone Areas.—These areas are all made up of small monoclonal blocks, which are potentially polyclone areas for purposes of tapping, where several clones come within a single tapping task. These areas are very useful as sources of mixed clonal seed. The results are presented in table IV. The yield figures are represented by larger acreages than those which appear in tables giving individual yields of the better known clones.

In general the yields are very satisfactory and compare very favourably with the yields of monoclonal blocks. Although the results are presented according to planting districts, comparisons will not be accurate owing to variations in clones and acreage figures.

Clones on trial at Dartonfield: WAR. 4, KD. 1, BD. 17, LUN. N, PB. 6/5, PB. 6/9, PB. 5/60, PB. 6/50, PB. 5/122, RRIM. 500 series and PR. 1. NAB. clones.—The yield results of these clones on an experimental scale are published in the Annual Report for 1951. From a trial of thirty four clones compared with clones TJ. 1 and WG. 6278 as controls, clones PB. 6/50, RRIM. 501, 513, 500, LUN. N, and WAR. 4 show promising yields. In the 1941 replanted area Dartonfield, RRIM. 501 with over eighty trees in tapping has given 17 pounds dry rubber per tree per tapping year at ten years of age. Clones KD. 1, BD. 17, and PB. 6/9 have not come to standard for further testing. PB. 5/122 and 6/5 show early indications of good yields in the first 3 months of test-tapping at Hedigalla, sub-station. NAB. clones 12, 15, and 20 seem to be the best after seven years tapping from an earlier selection of eight of these clones. Compared with control clones PB. 86, TJ. 1 and MK. 3/2, these three clones are worth a trial on a small scale in commercial plantations together with RRIM. 501, 513 and 500.

Clonal Seedlings.—It is evident from our correspondence on the planting of this material, that the nature of clonal seedlings is still not clearly understood. The outstanding difference between budgrafts of a single clone and clonal seed from this same clone is that in the former, the trees are really branches of a parent seedling tree and characteristics including yield can be expected to be uniform within this clone from tree to tree. In the latter no two seedlings established from a collection of seed will be identical in all characters with their parent clones. Each seedling will inherit only a proportion of the parental characters from the female and male side. The Hevea rubber tree being a hybrid will also show variability in "selfed" seed with no male parent outside the clone itself.

The practical implications are, therefore, quite clear. Where a clonal budgraft has been proved to be very high yielding with good secondary characters, it is more reliable than clonal seedlings. It is possible, however, that with clonal seedlings from reliable clone parents, yields equal to or even better than the best known clones can be obtained, provided the potentialities of this material are correctly exploited. Such results have already been obtained in many instances in outside countries, and with Prang Besar Isolated Garden Seed in Ceylon in Table V. Attention is drawn to our Advisory Circulars No. 19, 26 and 27 which deal with this subject.

According to the ' type ' of clonal seedlings depending on its clonal parents, the proportion of high yielding seedlings from an initial high stand per acre can be retained by selective thinning out of the poorer trees during the early years of tapping. Once a clone is pronounced a reliable parent for transmitting desirable characteristics to its progeny, changes in environment can have little effect on its genetic potentialities. In most cases seed gardens will have a number of such reliable parents. The so called " Clonal Seed " from clonal seedling areas is not recommended for planting.

Until the early local clonal seed plantations have been checked up for yields, the Rubber Research Institute can only recommend this material for planting on a limited scale. The reputation of seed gardens must be built up by the results produced from clonal seed obtained from each garden with its own particular collection of clone parents, and isolation against undesirable pollinations.

In many instances where owners are unable to give careful attention to budgrafted material, clonal seedlings should be most useful. Middle class and small holders, who have a limited acreage to plant will come under this category. " Selfed " seed of clone TJ. 1 collected centrally from TJ. 1 areas of about fifty acres and over, seem at present to be the most reliable. An area of " selfed " seedlings of TJ. 1 planted on 17 acres in Ceylon without selective thinning has given just over 1,000 lbs. dry rubber per acre in the 5th tapping year. Mixed seed from reliable clone parents will be a safe alternative.

The yields of Prang Besar Isolated Garden and Tjikadoe seedlings in Ceylon are summarised in Table V and VI. Yields well over 1,000 lbs. dry rubber per acre occur quite often after the third year of tapping : in most cases with low initial stands per acre and very little selective thinning. These areas would have produced considerably higher yields, if the recommendations with regard to a high initial stand and selective thinning had been carefully observed.

The popularity of clonal seed as planting material will also depend on the success of crown-budding high yielding budded rubber against Oidium leaf disease with Oidium resistant clone LCB. 870. The difficulty of carrying out the same procedure with clonal seedlings will be obviously due to selective thinning, which will take place after about the fourth or fifth year, when crown-budding presents special drawbacks to successful results. There is, however, the alternative of crown-budding the whole of the initial stand of seedlings at the correct age of about 18 to 24 months before thinning out. It would be premature to comment on the economics of such a procedure at the present stage.

The writer will also like to sound a final note of warning with regard to peak yields obtained in 1950—51 period, which may be due to fluctuations in yearly yields under normal existing tapping systems or deliberate overtapping to meet favourable market conditions. In the latter case there is a real danger of the trees, especially in young budded and seedling rubber areas, being unduly depleted of food reserves, resulting in poor yields in subsequent years. The more serious aspect of such overtapping will be poorer resistance to diseases in general, especially leaf diseases like Oidium heveae, and inability to refoliate sufficiently after serious defoliations. Manuring at this stage without proper foliage will fail to resuscitate such affected trees.

The writer has to acknowledge with thanks the co-operation of Estate Agents and Superintendents in sending in yield data.

TABLE 1

YIELDS IN LBS. PER ACRE AND AGE IN YEARS.

Estate	District	Clone	Acres	6		7		8		9		10		11		12		13		14		15		16		17		18		19	
				Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%	Yield	%
822	Passara	TJ.1	26															583		811	100	818	100	633	100	778	100	923	100		
		BD.5	14																	581	72	520	64	495	78	616	79	611			
284	Kalutara	TJ.1	456-19	457	100	626	100	711	100	712	100	701*	100	773*	100	796*	100	803*	100	876*	100	772*	100	768*	100	1051	100	1085	100		
		TJ.16	128-9	154	34	299	48	384	54	561	79	577	82	635	89	662*	83	646*	81	750*	86	732	95	797	104	709	67				
		BD.5	102-4[illegible]					483	68	556	78	842	120	848	110	903	113	1039	129	1056	121	1218	158	1198	156	1231	117	1270	117	1262	
350	Kalutara	TJ.1	35	346	100	475	100	543	100	585*	100	663*	100	845	100	1082	100	1142	100												
		TJ.16	10	319	92	567	119	645	119	458*	78	539*	81	748	89	948	88	863	76												
		BD.5	10	348	100	528	111	498*	92	596*	102	806	121	972	115	938	87	—	—												
		BD.10	10			567	119	617	114	533*	91	597*	90	858	101	1050	97	1112	97												
128	Kegalle	TJ.1	43-65	423	100	676	100	909	100	855	100	954	100	728	100	794	100	930	100												
		TJ.16	25	258	61	428	63	568	63	564	66	754	79	600	82	653	82	661	71												
[illegible]	Ratnapura	[illegible]	15-8									371	100	394	100	616	100	748	100	821	100	886	100	895	100	682*	100	395	100		
		[illegible]	22							630		519	140	593	150	657	107	548	73	621	76	561	62	499*	56	314	46	394	100	503	
[illegible]	Kalutara	TJ.1	112-61	509	100	441	100	644	100	740	100	641	100	980	100	1226	100														
		BD.5	54-25	329	65	462	105	482	75	667	90	667	104	987	101	1749	143														
26	K. V.	TJ.1	136-29			433	100	665	100	649	100	729	100	778	100	907	100	978	100												
		BD.5	111-24			554	125	800	120	875	135	827	113	878	113	1099	121	1604	164												
		TJ.16	63					346	52	414	64	448	61	692	86																
[illegible]	Kalutara	TJ.1	31	387	100	537	100	743	100	764	100	804	100	746	100	886	100	797	100												
		BD.5	19	371	96	466	87	782	105	792	104	836	104	1061	142	1125	127	1105	139												
476	Galle	TJ.1	11-22					346		534	100	540	100	732	100	1112*		725													
		AV.49	9							440	82	696*	129	405*	55																
[illegible]46	Kegalle	TJ.1	11			495	100	777	100	898	100	1098	100	1228	100	1323	100														
		AV.49	7			504	101	642	83	623	70	768	70	852	69	888	67														
[illegible]68	Kurunegala	TJ.16	5					829	100	982	100	1225	100	1147	100	969	100	685	100	828	100	884	100	1113	100						
		AV.49	6					601	72	624	63	994	81	814	71	851	88	524	76	888	107	694	79	746	67						
[illegible]	Matale	TJ.1	17½			443*	100	681	100	838	100	1107	100																		
		[illegible]	15½			337*	76	694	102	814	97	939	85																		
A	Kegalle	TJ.1	13	465	100	610	100	836	100	743	100	785	100	882	100	920	100	757	100												
		TJ.16	5	168	36	283	46	487	58	377	51	444	57	584	66	538	58	478	63												
[illegible]	Negombo	[illegible]	20			218	100	428	100	641	100	833	100	960	100	1028	100	1057	100	1105	100	1089	100								
		[illegible]	6			276	127	538	126	406	63	981	118	1108	115	1116	109	1155	109	1198	108	1165	107								
B	Kegalle	[illegible]	10	770	100	904	100	1040	100	1045	100	1050	100	1003	100																
		[illegible]	10	353	46	584	65	784	75	825	79	753	72	789	79																
[illegible]	Kalutara	TJ.1	18					250	100	274	100	532	100	607	100	860	100														
		[illegible]	18					273	109	286	104	494	93	550	91	710	83														
		[illegible]	18					284	114	300	109	598	112	617	102	802	93														
		[illegible].10	18					251	104	238	87	579	109	509	84	785	91														
152	Kalutara	TJ.1	23			338	100	505	100	663	100	848	100	932	100	922		914		1121		1143									
		BD.5	33			326	96	625	124	623	94	734	87	1079	116																
131	Kalutara	TJ.1	13-27	226	100	393	100	529	100	619	100	1018	100	885	100	998		1234													
		TJ.16	7½			350	89	555	105	697	113	773	76	1049	118																
		BD.5	7	189	84	262	67	402	76	671	108	870	85	865	98																
167	K. V.	TJ.1	45			193		330	100	439	100	563	100	624	100	831	100														
		BD.5	25½					226	68	385	88	533	95	568	91	841	101														
60	Galle	TJ.1	12											631	100	412	100	694													
		BD.5	25											645	102	782	190														
130	Kalutara	TJ.1	59	273	100	627	100	602	100	674	100	731	100	868	100	992	100														
		TJ.16	50	170	62	408		440	73	472	70	621	85	693	80	815	82														
172	Galle	TJ.1	22			259		580	100	569	100	735	100	783	100	634	100	638	100												
		BD.10	20					508	88	584	103	763	104	759	97	942	149	979	153												
		BD.5	26					241	42	447	79	547	74	704	90																
		TJ.16	22					317	55	472	83	473	64	733	94																
12	K. V.	TJ.1	8									1114	100	1134	100	1136	100	1090	100												
		BD.5	7½									645	58	752	66	1161	102	1280	117												
		TJ.16	17¼							554		621	56																		
808	K. V.	TJ.1	35½			236	100	367	100	476	100																				
		TJ.16	14¼			258	109	443	121	506	106																				
151	Kalutara	TJ.1	20			263	100	582	100	559	100	572	100	585	100	618	100														
		BD.5	50			314	119	306	53	260	57	655	114	921	157	965	156														
93	Kegalle	TJ.1	25	279	100	487	100	652	100	743	100	878	100																		
		BD.5	21	264	95	432	89	611	94	522	70	750	86																		
		TJ.16	8					304	47	445	60	793	91	608		754															
C	K. V.	TJ.1	17					294	100	595	100	742	100	531	100	635	100	768	100												
		BD.5	9					244	83	534	90	649	88	613	115	691	109	759	99												
		TJ.16	14					155	53	340	57	499	67	469	88	558	88	578	75												

* Reduced tapping intensity from 100% to 67% due to Brown Bast.

TABLE II

YIELDS OF CLONES GL. 1. TJ. 1. TJ. 16. PB. 86 IN POUNDS OF DRY RUBBER

Estate No. and District	Clone	Acres	Trees per acre Total	Trees per acre In tapping	6 years Per acre	6 years Per tree	7 years Per acre	7 years Per tree	8 years Per acre	8 years Per tree	9 years Per acre	9 years Per tree	10 years Per acre	10 years Per tree	11 years Per acre	11 years Per tree	12 years Per acre	12 years Per tree	13 years Per acre	13 years Per tree	14 years Per acre	14 years Per tree	15 years Per acre	15 years Per tree
141	GL. 1	19	140	36–125–134–130–132–133	136	3.8	326*	3.9	685*	5.5	729*	5.5	825	6.3	836	6.3	1147	8.6						
K.V.	TJ.1	25	140	58–118–121–108–117–124	225	3.9	447	3.8	709	6.0	812	6.7	838	7.8	819	7.0	922	7.4						
172 Galle	GL.1	9	158	91–112–129–144–146–150			330	3.6	925	8.2	973	7.5	1089	7.6	1403	9.6	1358	9.3	865	5.8				
	TJ.1	21	122	94–97–100–111–112–106			272	2.9	580	5.7	569	5.7	735	6.6	783	7.0	634	5.7	638	6.0				
350 Kalutara	GL.1	10	117	95–117–123–123–109–114			658	6.9	710	6.1	461*	3.7	684*	5.6	749	6.1	937	8.6	838	7.4				
	TJ.1	10	117	96–99–102–103–104–80–99			582	6.1	608	6.1	554*	5.4	626*	6.1	827	7.9	1082	13.5	1142	11.5				
	TJ.16	10	117	102–104–105–95–114			567	5.5	645	6.5	458*	4.5	539*	5.2	748	7.1	948	10.0	863	7.6				
	PB.86	10	120	101–104–109–112–111	407	4.0	549	5.4	568*	5.5	651*	6.0	1053	9.4	1333	12.0	1366	12.3						
	TJ.16	10	116	99–101–103–105–99	392	3.9	544	5.4	4[illegible]5*	4.6	549*	5.3	766	7.3	996	10.1	1096	11.1						
152 Kalutara	GL.1	6	125	78–107–114–116–124–117			447	5.7	481	4.5	891	7.8	903	7.8	1135	9.2	1409	12.0						
	TJ.1	8	108	79–95–100–96–99–96–97–100–95			355	4.5	544	5.7	727	7.3	841	8.7	891	9.0	1184	12.3	791	8.2	1069	10.7	1143	12.0
130	GL.1	25.5	115	79–102–112–104			360*	4.8	[illegible]35	5.2	671	6.6	850	7.6	1241	11.9								
Kalutara	TJ.1	36	109	91–104–103–104			603*	6.6	[illegible]80	5.6	631	6.1	739	7.2	897	8.6	1002	9.6						
	TJ.16	50	114	83–93–106–108			408*	4.9	440	4.7	472	4.4	621	5.9	693	6.4	815	7.5						
	PB.86	12	117	106–109–111–111			477*	4.5	[illegible]62	7.0	874	7.2	1034	9.3	1378	12.4								
	PB.86	12.5	130	106–123–123			370	3.5	[illegible]86	4.8	816	6.6	1092	8.9	1322	10.8								
107	GL.1	7	111	73–29–69	479†	6.6	439‡	15.1	427	6.1	510	7.4												
Kalutara	TJ.1	79	123	115–93–113–114	473†	4.1	610‡	6.6	738	6.5	933	8.3	950	8.3	1185	10.4								
284	GL.1	8	133	111–104–133–120					607*	5.5	574*	5.5	948	7.1	1101	9.2								
Kalutara	TJ.1	29	133	91–82–109–108					642*	7.0	560*	6.7	700	6.4	932	8.6								
308	GL.1	14	117	73–95–103			318*	4.4	[illegible]45	5.7	508	4.9												
K.V.	TJ.1	35.5	101	71–85–89			236*	3.3	[illegible]67	4.3	476	5.4												
	TJ.16	14.3	134	75–104–114			253	3.4	[illegible]43	4.3	506	4.4												
134	GL.1	21	121	118–117–107–109–108					[illegible]65*	3.1	586*	5.0	611*	5.2	922	8.6	956	8.8	1064	9.9				
K.V.	TJ.1	22	128	109–118–92–98–96					[illegible]86	2.6	414	3.5	472	4.0	613	6.7	769	7.8	765	8.0				
372	GL.1	10.5	118	76–118–116			242*	3.2	[illegible]74*	5.0	668	5.7	1068	9.2	1092	9.4								
Matale	PB.86	7	156	105–125–151–153			395*	3.8	[illegible]92*	5.2	774	6.2	1225	8.1	1342	8.9	1537	10.0						
166	GL.1	7.5	157	91–112–141–156			502*	5.5	[illegible]05	5.4	684	4.9	1271	8.2										
Kalutara	TJ.1	8.5	120	96–110–124–93–117			457	4.8	[illegible]49	6.8	801	6.5	624	6.7	903	7.7								
131	GL.1	10	119	75–101–109–107			389	5.2	[illegible]90	4.9	737	6.8	1054	9.9	1414	13.2								
Kalutara	TJ.1	27	116	93–100–109–112–107			423	4.5	[illegible]62	5.0	619	6.2	828	7.6	885	7.9	809	7.2	1101	10.3				
	TJ.16	13	125	91–50–121–123–120	298	3.3	362	7.2	[illegible]96	11.9	619	5.1	1208	10.0	1273	10.3	1147	9.6						
	PB.86	5	117	89–93–88	334	3.8	514	5.5	[illegible]77	8.4	852	9.7												
A	GL.1	2.25	164	93–147–149–134	408	4.4	444	3.0	[illegible]16	4.9	520	3.5	1034	6.9	1050	7.0	875	5.9	595	4.4				
Kegalle	TJ.1	13	170	113–127–131–129–127			465	4.1	[illegible]10	4.8	836	6.6	743	5.8	785	6.0	882	6.7	920	7.1	757	6.0		
	TJ.16	449	111	42–89–92–99–91	168	4.0	283	3.2	[illegible]86	5.5	376	4.1	443	4.5	584	5.9	538	5.4	478	5.3				
391	GL.1	4	123	118–121–123–122			440	3.7	[illegible]48	2.9	385	3.1	482	3.9	751	6.1	930	7.6	702	5.8	817	6.7		
K.V.	TJ.1	25	100	88–92–94–98–96–95					[illegible]48	2.8	362	3.9	518	5.5	624	6.4	589	6.0	537	5.5	654	6.8	641	6.7
167	GL.1	23¼	109	92–96–100–106–105					[illegible]00	2.2	417	4.3	470	4.7	499	4.7	782	7.4						
K.V.	TJ.1	45	128	80–111–114–123–128–121			193	2.4	[illegible]30	3.0	439	3.9	563	4.6	624	4.9	831	6.9						
	PB.86	12	132	98–111–124			448	4.6	[illegible]91	5.3	658	5.3	872	7.0										
	TJ.16	13	122	84–94–104–108					[illegible]06	2.2	280	3.0	288	2.8	358	3.3								
C K.V.	GL.1	10	139	80–85–95			409	5.1	[illegible]75	7.9	611	6.4	658	6.9	645	6.8	619	6.5						
	TJ.1	17	138	80–85–95			294	3.7	[illegible]95	7.0	743	7.8	531	5.6	635	6.7	738	7.8						
	TJ.16	14	139	80–85–95			155	1.9	[illegible]39	4.0	499	5.3	469	4.9	558	5.9	578	5.0						
	PB.86	9	139	80–85–95			348	4.4	[illegible]06	7.1	854	9.0	814	8.6	905	9.5	909	9.6						
561	GL.1	13	145	27–36–40–67–86–95	73	2.7	198	5.5	230	5.8	333	5.0	381	4.1	453	4.8								
Kurunegala	TJ.1	10½	119	84–83–88–90					298	3.5	512	6.2	499	5.7	567	6.3								
	PB.86	8½	117	50–63–77–97			174	3.5	348	5.5	343	4.5	486	5.0										
133	GL.1	12	115	31–66–102–107							203	6.5	559	8.5	582	5.7	1102	11.6						
Ratnapura	TJ.1	16	98	71–78–79–84					334	4.7	454	5.8	473	6.0	599	7.6	584	7.0	753	9.0				
	TJ.16	16	93	80–78–74–82–84					401	5.0	470	6.0	517	7.0	559	6.8	655	7.8						
151	GL.1	25	114	57–98–103							253	4.4	415	4.2	569	5.5								
Kalutara	TJ.1	20	116	86–83–103–102					582	6.8	559	6.7	572	6.9	585	5.7	618	6.1						
D	GL.1	13¾	130	88–106											608	6.9	629	7.2	622	5.9				
Matale	TJ.1	28¾	138	93											730	7.8	855	9.2						
	TJ.16	40	136	86–87											685	8.0	850	9.9						
	PB.86	16½	136	92									890	9.7	1104	12.0								
478	GL.1	36	112	99–105–109									628	6.3	812	7.7	820	7.5						
Kalutara	PB.86	12	119	102–116–115					572	5.6	827	7.2	837	7.3										
148	GL.1	6	125	125–117							608	4.9	888	7.1	992	7.9	1211	10.4						
Kalutara	TJ.1	9	112	113–112–109–105							641	5.7	605	5.4	857	7.9	1168	11.1						
385	GL.1	30	151	93–149–136					237	2.5	690	4.6	501	3.7	702	5.2								
Ratnapura	TJ.16	35	130	89–110–109	208	2.3	290	3.3	280	3.2	313	2.8	467	4.3										
	PB.86	38	134	101–126–115	228	2.3	555	5.5	888	7.0	911	7.9	1067	9.3										
410	GL. 1	5	137	133–141–142–142					698	5.3	1116	7.9	1173	8.3	1401	9.9								
K.V.	PB.86	6¼	142	112–142					607	5.4	1011	7.1												

* Tapping started on a reduced intensity of 67%

‡ Tapping discontinued on trees under 21 inches girth

† Tapped for 10 months only

TABLE III

YIELD IN LBS. PER ACRE

Estate	District	Clone	Acres	6th year		7th year		8th year		9th year		10th year		11th year		12th year		13th year		14th year		15th year		16th year	
				Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre	Trees	lb. per acre
172	Galle	MK 3/2	20					95	311	109	511	104	679												
172	,,	,,	10					62	249	72	374	82	438	84	730										
934	K.V.	,,	4					92	394	99	505	105	655												
410	,,	,,	5½			134	466	134	606	162	871	162	1174												
K	,,	,,	5							132	243	150	457												
220	,,	,,	29			76	220	76	370																
167	,,	,,	15			77	297	99	395	96	275	101	358												
3	,,	,,	7					82	284			94	599												
107	Kal.	,,	60½	83	284	104	386	107	583	110	736	111	1109												
330	,,	,,	11					87	257	107	571														
108	,,	,,	7	171	285	195	636	198	857	197	975														
238	,,	,,	18					108	469	108	482														
152	,,	,,	20					103	383	109	718														
131	,,	,,	5			79	346	79	593	75	594														
153	,,	,,	25½			99	262	106	485	104	732														
35	Rat.		8							131	407	148	654	149	660										
159	,,	,,	16¾							74	400														
555	,,	,,	1							184	642	176	1632												
176	,,	,,	3½							69	282	110	366												
220	K.V.	HC. 28	13½							16	644	117	769	117	837										
3	,,	,,	55½											117	909										
167	,,	,,	53½			96	232	103	352	109	468	115	501	115	657										
3	,,	,,	15															131	815						
410	,,	,,	3			100	318	113	575	116	597	118	577												
148	Kal.	,,	6			100	465	110	302	119	569	119	742	116	767	103	665								
152	,,	,,	45			95	281	99	475	100	633	101	830	98	841	95	951	94	912	93	1131	89	1038		
153	,,	,,	5			129	401	130	563	126	639	125	722	124	770	123	895	125	967						
131	,,	,,	4			122	469	131	712	133	894														
166	,,	,,	10½			90	453	98	619	141	839	144	836	129	1010										
151	,,	,,	26			103	289	104	468	105	614	105	616	82	586	85	765	84	899	56	1098	56	1159	52	1178
238	,,	,,	11					109	301	138	585														
372	Matale	,,	5	86	201	122	321	135	521	136	806	136	823	136	1036	138	1051								
561	Kur.	,,	7½			111	313	123	504	123	496	120	616	126	624	130	631								
467	Rat.	,,	5			75	239	90	388	126	547	126	867												
159	,,	,,	17							98	344	109	491	125	412	125	647								
167	K. V.	HC. 55	8															101	725						
167	,,	,,	5					125	319	125	664	128	890												
167	,,	,,	14			66	253	83	409	106	492	112	693												
3	,,	,,	26½											115	775										
3	,,	,,	9½									106	630												
152	Kal.	,,	5			84	254	113	533	120	854	121	945	105	1049										
152	,,	,,	9					92	325	103	544	105	1002	104	978	97	1012								
131	,,	,,	5			75	389	107	589	115	645	108	835	110	1038										
148	,,	,,	5							116	601	116	612	116	653	115	719								
410	K. V.	WG. 6278	14½			138	670	137	954	141	1501	141	1400												
220	,,	,,	13			77	349	77	703																
3	,,	,,	10½									107	1143												
3	,,	,,	21							121	783														
3	,,	,,	14					93	740																
152	Kal.	,,	12			87	214	94	589																
350	,,	,,	8					98	168																
330	,,	,,	11					117	529	123	868														
107	,,	,,	20¾					91	407																
35	Rat.	,,	5									89	377												
107	Kal.	AV. 352	8¾			93	243	110	494																
478	,,	,,	14							92	643														
3	K.V.	,,	4½									107	894												
555	Rat.	,,	2							165	692	158	1552												
167	K. V.	AV. 255	11½					110	422	119	430	119	568												
D	,,	,,	3½					84	315	92	606														
350	Kal.	,,	8					104	154																
555	Rat.	,,	4							150	560	150	1004												
167	K.V.	PR. 107	14½			65	239	86	334	93	545														
3	,,	,,	11½					55	684																
P	,,	,,	4					77	240	122	650														
284	Kal.	,,	13					87	556	112	844														
350	,,	,,	8					97	113																
330	,,	,,	11					82	357	106	504														
555	Rat.	,,	3							141	759	150	1434												

TABLE IV

YIELDS OF MIXED CLONAL AREAS IN COMMERCIAL TAPPING IN LBS. PER ACRE

	CLONES		AGE IN YEARS													
		Acres	6	7	8	9	10	11	12	13	14	15	16	17	18	19
KALUTARA	TJ. 1, TJ. 16, PB. 25, GL. 1	100					542									
	TJ. 1, 16, PB. 183, PB. 25, BD. 5, GL. 1	25					758									
	TJ. 1, 16, BD. 5	35		243	367	546	544	630	703							
	PB. 86, Mixed	15				256	635	813								
	TJ. 1, GL. 1	53.5		423	699	756	889	979	1063	1174						
	BD. 5, TJ. 1, PIL. B. 84, A. 44, PBIG.	28.5			302	512	560									
	TJ. 1, GL. 1, TJ. 16, PB. 25, BD. 5	52	195	403	431	644	741	830	877							
	TJ. 1, BD. 5, HC. 28	61		283	456	524	711	859	954	973						
	TJ. 1, HC. 28, MK. 3/2, PB. 6/9, PB. 5/122 PIL. B. 84, A. 44, PBIG seedlings (small acreage)	66.5			406	550	637									
	PB. 25, GL. 1	59.5			201	417	377	400								
	TJ. 1, BD. 5, PB. 186	100	167		325	439	496	584	655	740						
	TJ. 1, BD. 10	28		277	492	630	744	730	806	693	717	726	599			
	BD. 5, TJ. 1, HC. 28	23		267	532	701	748	751	845	747	866	737	628			
	BD. 2, 10, TJ. 1, 8, 16, PB. 23, 123, 186 AV. 49, 50, 152	23		324	579	729	901	957	1002	858	958	931	825			
	MK. clones, BD. 5, TJ. 1	24.5			254	455	609	637	720	796	732	869	664	810		
	BD. 5, HC. 55	35		186	357	587	692	768	999	1087						
	TJ. 1, BD. 5	12		431	633		770	906	962	1082	1068					
	TJ. 1, 16, BD. 5	47			429				480	504	681	642	874	800	1062	1073
	TJ. 1, 40, BD. 5, 10	50			374	405	405	362	463	616						
	PB. 25, 37, GL. 1, 32, BD. 2, 5	71			363	294	428	582								
	TJ. 1, BD. 5	20					758	1021	1067	1090	1118					
	GL. 1, TJ. 1, 16, BD. 5, S. 24, R. 393	34		178	384	494	495	776	711	853	744	849				
	PB. 86, TJ. 1, GL. 1	13			464	655	676	899	1056							
	TJ. 1, 16, PB. 25, 86, 186, R. 393, BD. 5, GL. 1, PBIG, PIL. B. 84	48					632	909	1023							
	BD. 5, 10, TJ. 1, GW. 24	26			500	659	823	798	810	648						
	PB. 86, GL. 1	53			417	660	792	936								
	TJ. 1, 16, BD. 5	86			455	589	749	728	891	903						
	BD. 5, 10, HC. 28, TJ. 1					541	639	808	763	839	703					
	Average yield per acre	1189.5	181	302	428	547	658	768	842	850	843	792	718	805	1062	1073
[illegible]	TJ. 1, 16, GL. 1, PBIG.	54.5	178	337	445	350	472									
	TJ. 1, BD. 10, TJ. 16, BD. 5, GL. 1	105	273	405	522	594	721	803								
	TJ. 1, BD. 5	57	244	373	528	662	936	974	1088	806						
	TJ. 1, 16, BD. 5, GL. 1	24	—	206	430	695	747	820								
	HC. 28, PB. 86, MK. 3/2, GL. 1	31			419	581	696	833								
	TJ. 1, 16, GL. 1, PB. 25	100				531	565									
	TJ. 1, AV. 49	100							1086	1116	1090	1319				
	HC. 28, TJ. 1, PB. 25	50						1075	1212							
	HC. 28, PB. 86, PB. 25, TJ. 1, BD. 5	48					1014		1334							
	TJ. 1, AV. 49, TJ. 18, BD. 10	8											1133	1305		
	TJ. 1, PB. 86, GL. 1	54	407	567	655	737	662	697								
	TJ. 16, MK. 3/2	15		175	600	667	735									
	TJ. 1, 16, GL. 1	23½	343	541	589	801	913	842	1130							
	TJ. 1, 16, GL. 1, BD. 5	54		320	487	706	680	1009	1030							
	Average yield per acre	724	289	366	519	632	740	882	1147	961	1090	1319	1133	1305		
[illegible]	TJ. 1, 16, PB. 25	99¼	—	374	619	—										
	M. 11, PB. 25	20						785								
	TJ. 16. BD. 5	20				909										
	Average yield per acre	139¼		374	619	909		785								
KEGALLE	TJ. 16, BD. 5	15½	265	558	676	660	855	702	760	847						
	TJ. 1, 16, BD. 5	42	244	492	499	551	617	638	790							
	PBIG. PIL. B. 84, PIL. A.44	25					651	718								
	TJ. 16, PB. 86, MK 3/2, P!L. B. 84	73		314	434	648										
	Average yield per acre	155½	255	455	536	620	708	686	775	847						
MATALE	TJ. 1, BD. 5, PB. 25	57				352										
	TJ. 1, TJ. 16	36				520	436									
	AV. 49 & Mix.	8							601							
	AV. 163, GL. 1	12							423	580						
	Average yield per acre	113				436	436		512	580						
RATNAPURA	TJ. 1, and TJ. 16	146			430	509	635	697	600							
	PB. 86, 84, AV. 163, 157, PR. 2, 107	12.5			293	503	668									
	TJ. 1, PR. 107	32			377	452	475	550	863							
	PB. 86, MK. 3/2 and WG. 6278	4				369	496	928*								
	TJ. 1, 16, BD. 5	96						568	600							
	Average yield per acre	290.5			367	458	569	686	688							

TABLE V

YIELDS OF PRANG BESAR ISOLATED GARDEN SEEDLINGS IN LBS. PER ACRE AND PER TREE. TAPPING SYSTEM S/2, d 2, 100%

Estate	Date of planting PB. seedlings	Date budded in field (F) budded stumps (S)	Acres	Control clone	YIELDS IN POUNDS																								
					1st Tapping Year				2nd Year			3rd Year			4th Year			5th Year			6th Year			7th Year			8th Year		
					Age in yrs.	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree
613	6/38		3		5¾	148	548*	3.7	141	807	5.7	140	874	6.2	139	1031	7.4	152	1275	8.4	150	1247	8.3	150	1395	9.3			
		6/38 (S)	7	TJ.1	5¾		462*		130	641	4.9	125	792	6.3	129	911	7.0	107	816	7.6	107	883	8.3	107	1041	9.7			
[illegible]	5/40		3½		6	84	323	3.9	98	674	6.9	115	750	6.5	129	822	6.4	123	1177	9.6									
	1/39		5		5¼	183	541	2.9	154	801	5.2	107§	724	6.8	153	1106	7.2	136	942	6.9	133	906	6.8	141	1220	8.7			
		6/38 (S)	25	TJ.1	5½	88	547	6 2	112	603	5.4	97§	662	6.8	114	926	8.1	94	671	7.1	89	737	8.3	99	1178	11.9			
152	6/38		5		5¾	157	507*	3.2	154	815	5.3	127	858	6.8	119	1007	8.5	131	927	7.1	126	1505	11.9	109	1408	12.9			
		6/38 (S)	5	PB. 25	5¾	92	251*	2.7	124	446	3.6	127	609	4.8	123	728	5.9	128	633	4.9	128	881	6.9	107	1234	11.5			
[illegible]	6/38		13		5¾	57	465*	8.1	85	499	5.9	109	630	5.8	107	871	8.1	104	891	8.6	105	951	9.1	104	970	9.3			
	6/39		23		5¾	72	286*	4.0	109	590	5.4	119	826	6.9	119	988	8.3	121	1052	8.7	120	1062	8.9						
		10/37(F)	21	TJ.1	5¾	115	412*	3.5	115	583	5.1	117	838	7.2	109	785	7.2	105	842	8.0	106	737	7.0	107	848	7.9			
		6–12/37(S)	10	TJ.1	5½	101	333*	3.2	101	440	4.4	103	643	6.2	94	742	7.9	95	766	8.1	97	755	7.8	96	924	9.6			
[illegible]	6/38		10½		5¾		251*	—	95	524	5.0	101	782	7.7	123	1019	8.2	120	1003	8.3	107	852	8.0	107	840	7.9	106	754	7.1
		6/38(S)	19	TJ.1	6¾	67	319*	4.8	68	518	7.6	68	552	8.1	94	763	8.1	95	664	7.0	95	820	8.6				96	840	8.8
107	5/40		55½		6	106	434*	4.1	121	805	6.6	121	982	8.1	123	1072	8.7	123	1204	9.8									
		5/39(S)	79	TJ.1	6	115	474*	4.1	92§	610	6.6	113	738	6.5	113	933	8.3	114	950	8.3	114	1185	10.4						
372	11/39 8/40		12½		5–6	105	329*	3.1	112	464	4.1	116	688	5.9	120	1255	10.5	121	1324	10.9	119	1329	11.2						
		11/38(F) 4/39(F)	17½	TJ.1	6–7	97	116‡	1.2	111	443	4.0	113	681	6.0	118	838	7.1	121	1107	9.2									
203	10/38		13		7	77	263*	3.4	123	627	5.1	138	708	5.1	139	820	5.9	133	1246	9.4									
		10/37(S)	32	TJ.1	8	59	261*	4.4	82	542	6.6	97	497	5.1	102	514	5.0	103	773	7.5									
159	4/38		5½		8	115	663*	5.7	161	821	5.1	165	862	5.2	165	924	5.6	165	1368	8.3									
		7/38(S)	17½	HC.28	8	78	303*	3.9	95	464	4.9	109	491	4.5	125	412	3.3	125	647	5.2									
536	1940		14⅓		5	29	78*	2.7	78	263	3.4	123	782	6.4	134	1046	7.8	150	1151	7.7	152	1352	8.9						
		1939(S)	7	TJ.16	5	56	179*	3.4	58	288	5.0	102	491	4.8	116	746	6.4	118	966	8.2	121	938	7.8						
131	6/40		15		5¾	108	433*	4.0	137	643	4.7	136	907	6.7	136	1137	8.4	132	1245	9.4									
		5/41	5	PB.86	6	89	334*	3.8	93	514	5.5	93	777	8.4	88	852	9.7												
139†	12/39		5½		7½–8	120	292	2.4	120	707	5.9	121	799	6.6	121	817	6.8												
		9/37	12	TJ.1	7	81	537	6.6	85	666	7.8	94	595	6.3	94	725	7.7												
350	7/40		28		7	88	272	3.1	95	390	4.1	112	593	5.3	112	973	8.7												
		7/40(S)	22	PIL.B84	7	65	183	2.8	84	349	4.2	100	572	5.7	100	753	7.5												
478	11/38		12		6	99	540	5.5	98	577	5.9	97	460	4.7	95	754	7.9	91	752	8.3									
		[illegible]/41(F)	12	PB.86	7	50	142	2.8	102	572	5.6	116	827	7.1	115	837	7.3												
151	4/38		25		7	102	397	3.9	102	586	5.8	106	587	5.5	103	752	7.3	104	784	7.5	101	795	7.9						
		10/38	20	HC.28	7	103	289	2.8	104	468	4.5	105	614	5.8	105	616	5.9	106	684	6.4	111	705	6.4						

§ Tapping discontinued on trees under 21'' girth. *Tapped from 8 to 10 months only.
‡ 6 months tapping. † Includes 2½ acres of Pilmoor seedlings which yielded less than PBIG seedlings.

TABLE VI

YIELDS OF TJIKADOE SEEDLINGS IN POUNDS PER ACRE AND PER TREE

[illegible]	[illegible]	Acres	Age in yrs. when 1st tapped	1st Tapping Year			2nd Tapping Year			3rd Tapping Year			4th Tapping Year			5th Tapping Year			6th Tapping Year			7th Tapping Year			8th Tapping Year			9th Tapping Year			10th Tapping Year			11th Tapping Year			12th Tapping Year		
				No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree	No. of trees	Per acre	Per tree
[illegible]	[illegible]	[illegible]	9	[illegible]	153	4.8	73	406	5.6	73	565	7.7																											
[illegible]	[illegible]	[illegible]	8	147	246	2.4	147	573	3.9																														
[illegible]	[illegible]	10	11	[illegible]	501	5.1	97	552	5.7	100	452	4.5	104	477	4.6	105	775	7.4																					
[illegible]	[illegible]	[illegible]	13	[illegible]	[illegible]	7.1	130	826	6.4	130	712	5.5	130	969	7.5	130	1069	8.2	130	1054	8.1	130	1036	8.0															
[illegible]	[illegible]	[illegible]	10	[illegible]	[illegible]	3.2	101	446	4.4	105	511	4.9	100	458	4.6																								
[illegible]	KAL	50	9	[illegible]	[illegible]	4.2	127	806	6.3	127	970	7.6																											
[illegible]	[illegible]	[illegible]	12	[illegible]	[illegible]	2.4	66	243	3.7	74	369	5.0	78	385	4.9																								
[illegible]	MAT.	11	12	[illegible]	[illegible]	3.4	90	333	3.7	94	485	5.2	100	697	7.0	100	712	7.1	100	627	6.3																		
[illegible]	PAT	[illegible]	22	[illegible]	916	10.0	101	1112	11.0	110	1189	10.8	99	1217	12.3	99	1019	10.3	99	1074	10.8	99	1144	11.6	99	1113	11.2	99	1113	11.2	99	1192	12.0	100	1056	10.6	103	1218	11.8
	RAT	5	10	[illegible]	[illegible]	6.6	124	732	5.9																														
	[illegible]	[illegible]	9	[illegible]	[illegible]	2.1	106	426	4.1	112	620	5.5	113	672	6.0																								

THE WORK OF THE SMALLHOLDINGS DEPARTMENT, RUBBER RESEARCH INSTITUTE

By

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Smallholdings Propaganda Officer

Origin and Development

THE Smallholdings Department came into existence as the result of a realisation on the part of the Board of Management in 1935 that, although large estate owners in Ceylon derived considerable help and benefit from the work of the Rubber Research Institute, there were no facilities whatever to make these benefits available to the small owner. This seemed unreasonable both in view of the fact that small owners possessed an appreciable proportion of the Island's Rubber and contributed the same cess for the maintenance of the Institute as the larger owner.

In September 1935 the writer was sent on a two-months' visit to Malaya to study the Smallholders' Advisory Service of the Rubber Research Institute of Malaya prior to inaugurating a similar service in Ceylon. A start was made with the appointment of two Rubber Instructors at Matugama and Horana in November 1936 to help and advise smallholders of the district and of a Clerk-Translator to attend to clerical work and translate advisory leaflets. As a result of the useful work done by these two Instructors, four additional Instructors for Galle, Kelani Valley, Kandy and Ratnapura were appointed in 1938 and four more for Kegalla, Gampaha, Akuressa and Elpitiya ranges between 1941—1946, making a total field staff of ten. An Assistant Propaganda Officer was appointed to the department in 1947 to ensure the closer supervision of work in the ranges.

In October 1948 the entire work of the New Rubber Planting Scheme, which was an organisation of considerable magnitude, was taken over, resulting in the writer's staff being increased to 3 Assistant Propaganda Officers, 4 District Field Officers, 31 Rubber Instructors, 4 Clerks and 2 Peons at which strength it functions at present.

Functions and Scope

The principal function of the Department is to render free assistance and advice to Rubber smallholders regarding matters connected with the cultivation, maintenance, manufacture and marketing of rubber. These services which were previously confined to owners of mature plantations and replanters, were considerably increased with the taking over of the N.R.P.S. in 1948, when an additional 50,000 acres (nearly) of young new-planted Rubber, mostly budded, came under the special purview of this Department.

There are approximately 655,000 acres of Rubber in Ceylon, of which 168,000 acres are smallholdings of below 10 acres and a further 141,000 acres of small estates of 10—100 acres. The needs of all the 168,000 acres of smallholdings and part of the 141,000 acres of small estates are catered for by the Smallholdings Department. For 1950 approximately 51,000 acres out of the total 655,000 acres in Ceylon consisted of budded rubber, the bulk of which, namely

about 39,000 acres, are small estates (10—100 acres) and smallholdings (less than 10 acres) planted under the New Rubber Planting Scheme. Most of these receive the special attention of this Department.

Services Rendered

The services rendered are varied and comprehensive. No small owner need have a Rubber problem today concerning which he cannot obtain free advice from the Smallholdings Department or his local Rubber Instructor, in addition to the many practical benefits he receives in the way of planting material, lining and grants for soil conservation, mesh for strainers, guaranteed acid etc. The 31 Rubber Instructors are stationed in 31 specified ranges which cover all the main Rubber districts and each is responsible for the smallholdings in his area. 7—8 Rubber Instructors are supervised by a District Field Officer, and the divisions of 2 District Field Officers by an Assistant Propaganda Officer.

Systematic visits are paid to holdings by Instructors where talks and demonstrations are given to individuals or groups of smallholders. Practical demonstrations are conducted in sheet-making, tapping, budding, disease-treatment, compost-making etc. Holdings are lined for contour drains with the road-tracer free of charge, and on new-planting permit-areas grants are paid after the drains are completed. Rs. 14,424/-, Rs. 5,191/- and Rs. 7,942/- were paid as grants to 202, 75 and 151 peasant-class permit-holders during 1949, 1950 and 1951 respectively. The work done on each holding is carefully measured, checked and certified by the field staff before a grant is paid.

Frequent visits are paid by Instructors and all stages of work supervised whenever a smallholder is new-planting or replanting his land. Lists of all permits issued by the Rubber Controller are received by the writer and forwarded to the officer of the range concerned, who visits them within 2 weeks and does all that is necessary to ensure a satisfactory plantation.

General advice and supervision in maintaining, and where necessary replanting, Government Rubber Allotments given to colonists is undertaken. During 1951 all operations in replanting 87 acres of the Urumiwela Allotments were supervised and approved planting material in the form of clonal seedlings was supplied. All allotments were planted on up-to-date lines with proper soil conservation measures, etc. and are making satisfactory growth.

Sheet Improvement

Considerable attention is paid to the improvement of smallholders' sheet so that it might fetch the best possible price. Inexpensive wattle-and-daub smokehouses of varying sizes which produce excellent sheet have been designed to suit all classes of small owners. Two demonstration houses are put up in each range annually at Departmental expense and small owners encouraged to build similar ones. Over 250 demonstration and 500 private smokehouses have been built to date under the Department's supervision.

The improvement of sheet by co-operative methods, where several small owners form themselves into a Rubber Co-operative Society and bring their latex to one centre to be converted by a trained rubber maker into grade I sheet, has been given considerable attention. The Hataraliyadda Rubber Co-operative Society, initiated by this Department, has proved a great success and other similar societies have been formed by this Department at Dapiligoda, Kahagalla, Aruppola, Dediyagala and Maliduwa. The main snag in forming more such societies is the difficulty that smallholders experience in obtaining

an initial loan of Rs. 2,000/- to Rs. 3,000/- for putting up the necessary smoke-house and coagulating shed and buying a pair of rollers. The writer has appealed to the Board on the desirability of making some provision for these loans, which would be amply repaid by the better sheet produced, and it is hoped that some early arrangement will be made.

Mesh for strainers and reliable acid in sealed bottles are sold by Rubber Instructors at concession rates. Quality Certificates and free pans are issued to those who make good sheet.

Latex Centres

The Department has been responsible for organising a scheme whereby small owners in the Kalutara District could supply their latex to the central buying organisation at Katukurunda at rates considerably more advantageous than what they get by making sheet. Latex is brought by each member to a given centre and there "weighed", bulked, ammoniated and handed to the lorry which calls daily. The organisation pays 2 cents below the day's top market price of sheet for every pound of dry rubber supplied as latex and also supplies the collecting tanks etc. 11 Centres are each supplying 20-100 gallons of latex per day at present with considerable benefit to their members. The Centres have applied to the Co-operative Department for registration as Latex Co-operative Societies.

New Planting

On taking over the N. R. P. S. in 1948 it was found that no record existed of the actual condition of the large number of holdings planted under the scheme since 1939. A holding-to-holding survey was, therefore, undertaken in 1949 and an up-to-date record obtained. A total of 20,845 permit-areas were visited by Instructors and returns filled in respect of 18,654. Holdings were classified into 3 groups according to their growth. Out of 25,853 acres of middle-class permit areas, 34% fell into "class 1" (i.e. satisfactory growth), another 34% into "class 2" (i.e. growth poor but capable of improvement) and 25% into "class 3" (i.e. very poor growth not likely to make satisfactory plantations). Similarly out of 12,424 acres of peasant-class permit areas 34% fell into class 1, 30% into class 2 and 29% into class 3; and out of 698 acres of colony areas 16% fell into class 1, 26% into class 2 and 51% into class 3. 58% of middle-class, 54% of peasant-class and 54% of colony holdings were found planted with budded rubber, the remainder consisting mainly of ordinary rubber and to a small extent of clonal seedlings.

The survey which took one year to complete also gave much useful information regarding soils, gradients of lands, tapping conditions, soil conservation etc. on these holdings and has furnished a record of each holding whose future progress will be noted by the staff at each subsequent visit.

The demand for new-planting permits continued during 1951, and 4213 middle and peasant-class permits covering 6526 acres were issued by the Rubber Controller. Each land is inspected by a Rubber Instructor before a permit is given. 5087 inspection reports were sent to the Rubber Controller in 1951.

A close watch is kept on new-planted holdings which are nearing tapping age and Instructors continually visit them and mark tappable trees and direct operations on correct lines. This is important owing to the tendency among smallholders to tap daily, which often results in a high percentage of brown-bast on new budded plantations.

Planting Material

The Department supplies large quantities of approved high yielding planting material to small owners annually. Clonal seedlings, which are hardier and easier to manage, are supplied to such limited extent as they are available, besides fairly large quantities of budded stumps of proved clones like PB. 86. Plants are supplied free to peasants and at a nominal charge to middle-class permit-holders and replanters.

In 1951, 48,823 clonal seedlings were issued free and 28,745 sold. 6925 budded stumps and 280 yards of budwood were also sold. The germination of the clonal seed crop in 1951 was a failure and only 12,000 plants were obtained from 107,000 seed, for 1952 issue. A large nursery of 78,000 ordinary rubber plants was, therefore, laid for budding and issue as budded stumps in October-December 1952. All nurseries are planted and maintained under the supervision of the Department.

Replanting

The extent of replanting done by smallholders in Ceylon is quite inadequate and almost negligible in comparison with that done in other Rubber producing countries like Malaya. This is mainly due to the lack of capital. The attention of the authorities has been drawn to the need for providing some financial aid to encourage replanting and it is learnt that Government is considering a "Replanting Subsidy Scheme". A large proportion of smallholdings which were slaughter tapped during the war years are now uneconomic and need immediate replanting with high yielding material if Ceylon's place in the Rubber world is to be maintained.

Replanting work under the supervision of Rubber Instructors was completed on 103 holdings in 1951 comprising 126 acres. Replanting permits issued by the Rubber Controller in 1951 were 96 (covering 160 acres) to holdings of under 10 acres and 227 (6,024 acres) to estates of over 10 acres.

Lining for Soil Conservation

Instructors lined 1,661 acres on 1,350 N.R.P.S. holdings, 131 acres on 109 replanting holdings and 76 acres on 40 mature holdings for contour drains and stone terraces against soil erosion during 1951.

Other Work

Propaganda in improving smallholdings is also carried out by means of leaflets, issued both in Sinhalese and English, on useful Rubber subjects, advisory correspondence, competitions, lectures, participation in agricultural shows etc.

The following leaflets have been issued :—

(1) Budding and After-Treatment.
(2) Replanting.
(3) Sheet Making and Smoking.
(4) Tapping of Young Budded Rubber.
(5) Rubber Production on Smallholdings (handbill).
(6) Scheme for Supply of Smallholders' latex to the Latex Corporation, Katukurunda (handbill).

All field staff are given a special course of instruction in Rubber work on first appointment. This consists of lectures by the writer and practical work in budding, tapping, road-tracing, etc. at the Experimental Station, Nivitigalakele.

CLONAL SEEDLINGS*

By

THE LATE PROF. DR. P. J. S. CRAMER

WASSENAAR, HOLLAND

1. Seedlings and Clones, old and new

In 1950, shortly before the war with Japan broke out, I was invited to give a lecture on this subject to a planters' society in East Java. For several years there had already been a tendency in all rubber producing countries to give in addition to budgrafts, clonal seedling families a place in the replanting programme. One of the first countries where this movement began, was Sumatra, where from the time when the first budgrafts planted out in 1919/1920 started to produce seeds, experiments were laid out for studying this planting material. Even with the planting of these first budgrafts by the Avros station they were generally put into biclonal isolated plantings with the idea of obtaining seeds from combinations of high yielding mother trees.

The manuscript of the lecture was lost at the beginning of the war but a reserve copy was afterwards found and it was published in the " Bergcultures ", Java (1949, p. 122—133). The subject may be considered of distinct importance, as under present conditions the planting of clonal seedlings certainly has its attractive side, as it does not take so long in preparation as the planting of clones generally does, when budwood must be multiplied and nurseries made for raising stocks to bud ; the planting of germinated clonal seeds also requires less labour. I have always been in favour of using every year, in carrying out a replanting programme a part of the area for clonal seedlings, in order to get acquainted with this material with its peculiarities, for it must not be thought that it has the same demands as the old unselected seeds. To get the full benefit out of the planting of clonal families requires a separate technique and it is only possible to gain experience of the latter by practical experience. There is as yet no firmly established routine and much of it still depends on personal views.

Generally speaking the yield of clonal seedling families is not inferior to that of good clones as can be seen in Table I, which gives yield figures for small areas of both kinds of material. 100 kg. dry rubber per ha is equivalent to 90 lbs. per acre. The table was published by Schmole (1940).

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* The Rubber Reserch Board welcomes papers on subjects of general interest from outside contributors, but does not accept any responsibility for the views expressed therein.

TABLE 1

(COMPARISON OF YIELDS WITH CLONES AND WITH CLONAL SEEDLINGS IN kg. p ha (1 kg. p. ha EQUIVALENT WITH O.9 LBS. PER ACRE)

		Trees p. ha		Year of life				
Planted	Area	Planted	In tap	5th	6th	7th	8th	9th

23.	12.5	20.3	30.7	29.2	35.2	9.0	34.8	69.0	57.5	62.2		38.1	54	14	5
24.	7.5	19.8	29.0	32.1	35.6	49.6	50.4	43.1	38.6	70.1		37.6	54	8	7
25.	10.9	19.3	22.3	20.1	22.9	17.5	30.0	44.8	46.2	40.5		27.5	54	14	12
26.	11.2	18.3	25.8	25.1	23.3	31.8	38.2	37.4	41.9	48.6		30.2	54	8	2
27.	6.6	17.8	30.2	31.4	34.0	51.0	44.0	36.9	59.9	76.6		38.8	53	14	5
28.	—	17.4	25.1	28.2	32.3	36.1	20.8	3.7	4.3	17.8		18.6	54	8	6
29.	—	14.6	33.2	29.9	37.3	38.0	45.5	49.8	57.8	54.4		36.1	54	8	10
30.	—	14.4	27.5	40.3	38.2	41.6	73.9	66.7	57.9	52.9		41.3	54	14	5
	66.1	182.8	276.8	275.0	304.2	328.3	410.7	407.8	425.8	524.8	320.2	320.3			
GROUP IV.															
31. ..	—	14.2	20.8	23.8	34.0	46.3	53.6	50.6	46.5	57.2		34.7	53	14	7
32.	8.9	13.4	16.3	19.6	21.2	31.5	38.8	37.4	40.1	54.5		28.2	54	8	9
33.	—	12.2	25.3	22.3	32.1	47.6	41.0	50.3	11.5	43.9		28.6	54	8	13
34.	—	11.1	22.8	26.2	10.5	12.7	50.6	59.5	75.8	68.8		33.8	53	14	4
35.	5.6	11.1	8.4	13.0	9.6	4.4	13.1	11.0	13.6	11.5		10.1	54	14	2
36.	—	10.5	18.2	16.6	19.9	30.3	24.8	31.8	31.2	37.0		22.0	53	14	1
37.	—	9.8	13.5	28.8	37.7	36.3	50.2	63.5	58.1	65.9		36.4	53	14	2
38.	11.0	9.7	29.5	30.7	31.6	36.6	35.5	27.7	25.3	43.3		28.1	53	14	14
39.	8.2	9.3	16.7	17.1	23.6	23.4	40.4	43.8	39.8	32.6		25.5	54	14	8
40.	—	9.1	21.5	18.8	25.4	30.7	34.5	47.3	52.3	64.5		30.4	54	8	11
	33.7	110.4	193.0	216.9	245.6	299.8	382.7	422.9	394.2	479.2	277.8	277.8			
GENERAL TOTAL ..	435.0	910.5	1256.1	1281.4	1319.4	1528.4	1848.6	1975.0	1669.9	2161.4	1438.5	1438.8			

TABLE II.

Clonal Seedling Family AV 282 yield in gr. dry rubber av. p. tree p. tapping 10 successive years of life

(*See Rubber Archief*, 1935 *p.* 165)

YEAR	5	6	7	8	9	10	11	12	13	14	Aver. for 10 Years	Place in the field		
GROUP I														
1.	18.7	38.8	63.6	55.6	34.6	36.8	37.7	54.3	51.0	66.8	45.8	54	14	14
2.	21.2	37.1	45.8	46.3	52.0	69.2	102.9	106.7	86.4	98.5	66.6	54	8	3
3.	23.6	36.5	bb.	—	—	60.0	46.8	65.5	81.1	133.8	44.7	53	14	12
4.	16.5	36.2	30.3	48.2	38.3	45.0	63.7	54.2	54.2	61.2	44.8	54	14	4
5.	20.3	35.6	54.6	50.0	47.5	47.9	29.2	34.4	33.7	41.8	39.5	53	14	13
6.	14.1	34.3	42.5	26.3	48.4	12.8	55.7	37.3	41.3	48.8	36.2	54	8	12
7.	21.6	31.6	33.8	30.5	38.6	57.0	51.5	55.1	43.4	27.8	39.1	54	14	6
8.	18.1	30.9	38.1	42.7	47.8	50.7	55.0	49.6	45.9	43.8	42.3	53	14	10
9.	10.5	29.8	31.4	33.5	46.3	42.5	56.5	79.7	47.1	103.5	48.1	54	8	14
10.	8.7	29.6	41.2	41.0	27.2	57.5	65.3	84.6	9.1	—	36.4	54	14	1
	173.3	340.4	381.3	374.1	380.7	479.4	564.3	621.4	493.2	626.0	443.4 443.5			
GROUP II.														
11.	18.2	29.4	42.4	37.0	39.4	58.3	41.4	7.4	21.3	34.0	32.9	53	14	9
12.	13.8	29.0	50.0	46.8	42.2	56.1	58.5	74.9	48.1	57.7	47.7	54	14	11
13. ..	14.0	27.9	39.5	43.4	42.8	55.2	80.1	84.6	41.2	93.8	52.3	54	8	1
14.	13.2	27.7	35.3	42.7	40.0	31.7	32.2	38.2	47.9	75.9	38.5	54	14	9
15.	14.2	26.6	27.9	32.7	45.7	45.0	58.9	63.4	51.2	85.3	45.1	53	14	11
16.	17.2	24.8	26.2	26.4	30.6	34.2	32.1	31.5	26.5	23.0	27.3	54	8	5
17.	20.4	44.7	52.6	31.6	49.1	53.3	42.8	44.4	36.0	29.7	40.5	54	14	13
18.	11.6	23.9	36.5	33.1	29.4	12.6	—	—	—	—	14.7	53	14	6
19.	20.5	22.2	57.7	78.0	53.7	47.6	108.3	142.3	58.6	95.5	68.4	54	14	7
20.	18.8	20.7	36.9	43.7	16.0	26.9	36.6	36.2	25.9	36.5	29.8	54	14	10
	161.9	276.9	405.0	415.4	388.9	420.9	490.9	522.9	356.7	531.4	397.1 397.2			
GROUP III.														
21.	8.5	20.6	37.1	38.7	45.4	53.7	53.1	55.8	61.7	101.7	47.6	53	14	3
22. ..	8.9	20.3 bb.	15.9	—	—	—	—	—	—	—	4.5	54	8	4

Table II contains the annual yield figures of 40 illegitimate clonal seedlings of AV. 282, for the first 14 years of life, *i.e.* for 10 or 9 tapping years. This table shows how the yield of each individual tree varies in the course of its life in accordance with factors such as tapping height and especially under the influence of brown bast. When these individual records are compared it is seen that the figures are by no means parallel for all the trees and that sometimes sudden falls in the yield occur. Generally speaking trees may be classified according to their individual yields and are found then to keep true to their class. A good deal of evidence on this point was put together in the " Handbook " (Swart en Rutgers 1921, p. 230—254). A striking instance is an experiment by Hamaker, who divided a certain number of trees in tapping into four classes according to their individual yield and then planted them together ; all trees kept to their class (Handbook, p. 245).

Table III gives an idea of the yield per day in the successive months of 4 years for two high yielding trees found in a planting of unimproved seedlings on Pasir Waringin Estate, West Java (from Handbook, 1921, p. 17).

TABLE III

INDIVIDUAL YIELD PER TREE PER DAY IN 48 SUCCESSIVE MONTHS FOR TWO HIGH YIELDERS ; PASIR WARINGIN ESTATE 1915—1918

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Extremes	Aver. daily yield
KD 127 (9th year) 1915	31	22	42	84	45	48	69	38	25	20	—	20	20— 84	40.4 gr.
(10th year) 1916	68	40	72	75	76	49	41	75	25	56	—	—	25— 76	57.7 gr.
(11th year) 1917	41	48	45	49	50	45	90	36	55	65	31	72	31— 90	52.3 gr.
(12th year) 1918	104	50	51	43	49	65	49	—	18	35	50	54	18—104	51.6 gr.
KH 160 (6th year) 1915	25	24	64	55	15	56	50	42	40	39	45	34	15— 64	40.8 gr.
(7th year) 1916	59	35	30	21	70	62	46	35	31	17	53	29	17— 70	40.3 gr.
(8th year) 1917	66	47	54	50	80	55	80	41	45	40	35	45	35— 80	53.2 gr.
(9th year) 1918	40	50	68	46	45	54	40	60	35	60	60	50	35— 68	50.7 gr.

It is interesting to compare the yield classes of clonal seedlings and with the old unimproved material.

TABLE IV

COMPARISON OF YIELD CLASSES WITH CLONAL SEEDLING AV. 282 WITH UNIMPROVED SEEDLINGS FROM GRANTHAM'S TABLE

Yield Class	AV. 282 Clon. Seedl.	AV. mult. by 23	Grantham's unimproved seedl.
Under 1, 1 kg p. year ..	1	23	42
1, 1— 2, 2 ..	1	23	351
2, 2— 3, 3 ..	2	46	313
3, 3— 4, 4 ..	4	92	127
4, 4— 5, 6 ..	9	207	52
5, 6— 6, 7 ..	12	276	22
6, 7— 7, 8 ..	8	184	7
7, 8— 8, 9 ..	1	23	3
8, 9—10 ..	—	—	1
10 —11, 1 ..	2	46	—
	40	920	918

Grantham's figures relate to a field of 12½ acres with 918 trees; the yield was recorded during 9 years and trees were then divided into yield classes of 0—10 kg, 11—20 kg, etc. To make the figures comparable with the annual

yields of the clonal seedlings the yield classes based on the total yield of 9 years had to be divided by 9. There were 40 trees in the Avros set, and 918 trees in Grantham's field; we may put the latter figure then at 920 trees, or 23×40. When in the case of the Avros trees the class figures are multiplied by 23 the figures so obtained can be compared with Grantham's figures. The far higher yield level of the clonal seedlings compared to the trees grown from unimproved, ordinary seeds 1), is seen at once. The latter are grouped mainly in the classes 1, 1-2, 2 kg and 2, 2-3, 3 kg, whilst with the clonal seedlings most of the trees are in the class of 5, 6-6, 7 kg. If the planting had consisted of clonal seedlings the acre yield would have been more than doubled.

2. Prejudice against budgrafts

The difference of clonal seedlings from the ordinary unimproved seedling material of the old days is their higher average yield, and connected with the latter their greater liability to bark diseases, especially brown bast. The resistance against windbreak seems to be generally somewhat better in seedlings, than in budgrafts. In the first years during which budgrafting became a routine technique in the rubber planting industry—say in the period 1925-1930—there was a general belief that budgrafts showed generally less favourable secondary characters, than seedlings and this was for many planters a reason to prefer the latter planting material. However, it was not sufficiently realised that this might be true for the old class of unimproved seedlings, but that high yielding clonal seedlings were similar to high yielding clones in this respect, at least in regard to brown bast. Other secondary characters like stand and form of the stem (leaning or straight, cylindrical or not cylindrical) renewal of the bark after tapping and wound recovery are generally better with seedlings—also high yielding clonal seedlings—than with clones. One has only to compare the secondary characters as noted by Schmole for his clonal families: practically all obtain the mark " good ". For the bark renewal however there is sometimes noted (for seedlings of AV 49 and AV 185) slight ridging whilst for the many clones in the same test garden bark renewal is often mentioned as " uneven ", " ridging ", " burrs " and also the wound recovery is often described as unsatisfactory. The same is true for the growth (see table of Schmole, 1940).

On the other hand the first clones developed in those days were mainly chosen for high yield and too little attention was given to their secondary characters. When budgrafting had become more general, gradually more data became known, a much richer variety of clones became available and it became possible to choose clones with excellent growth and renewal. It was realised then, that the difficulties were less the result of budgrafting than of the high yielding capacity of the material and that even in a comparison of both kinds of material clones might be preferable as one was much more sure of the secondary characters than with seedlings. To cite only a few experts, in 1927 Grantham stated that careful observations of clones over extended periods had been found to be necessary, and mentioned that for instance clones had been found (1) particularly susceptible to disease (2) with a distorted renewal surface similar to the protuberances caused by brown bast (3) in which the yield fails to increase with age and even declines. A similar opinion was expressed by Ashplant (1928), when he stated he had discovered snags with buddings: weak growth, weak renewal, possibly greater susceptibility to disease, undoubtedly greater susceptibility to brown bast. Soon afterwards this statement was contradicted (Cramer, 1930, p. 8). I said: "Those who are familiar with our present clones will not share this opinion. On the contrary we have clones which

1. This seed, called also "Natural Seed" or in Malay "Sapoe Seed" as it has been swept together in unimproved plantings, has also a characteristic name in French, "tout venant."

in vigour and resistance against diseases surpass our common seedlings. There is a special point in favour of budgrafting, compared to seedling selection and that is the great uniformity in special characters."

Later experience with both kinds of planting material has confirmed these views of 1930, especially the last point. Since then clones became popular, which for their secondary characters are certainly not inferior to first rate clonal seedling families, and they have as well the advantage over the latter that with such a clone one is sure of the material: once it has been proved for the conditions of the estate it will always repeat its favourable characters. One of the drawbacks of clonal seedlings is that this is the case in a far smaller degree and although there are now known families of legitimate biclonal origin of which, especially when the planting is carried out in a way allowing drastic thinning, a high yield may be expected. Clonal families descending from mixtures of several clones for which the part each clone has taken in the seed mixture is not known do not give the same certainty. They may offer the attraction of a chance of high production and a possibility that, by a well planned policy of dense planting, careful thinning out of diseased trees, and by a tapping system adaptable to the individual seedlings, disease may be kept under control. Compared to the situation in the beginning of the budgrafting period the positions have been reversed. When we think of a clone such as PR. 107, with excellent growth and renewal, a high acre yield continuing to increase, little disease and windbreak there must still be accumulated a good deal of experience on clonal families before they should be generally preferred. In the beginning the establishment of plantings of clonal seedlings may require less labour and preparation, than the planting of clones, but the latter, if chosen from the more modern, resistant, well yielding ones, once well established will be less demanding and less risky. This is, of course, no reason not to put in part of the areas to be replanted clonal seedling families, but the planter should realise the particular difficulties of this material.

3. The yield in general

It has already been stated, that generally speaking the yield of good clonal seedling families is not inferior to that of good clones as can be easily seen in Table I, giving yield figures for small areas of both kinds of material. The table was published by Schmole (1940).

As may be seen from the table by comparing the top half with the bottom half the yield figures are of the same level for both kinds of material and the numbers of trees which have already been reduced somewhat by thinning out are also nearly equal, as is stated in the text. Schmole mentions further that with this thinning out of the mixtures of clonal families an equivalent number of trees has been kept of each family. If only the best producing families had been kept the acre yield would have been considerably higher for the seedling mixtures.

From comparison of the figures it may be concluded that good clonal families give on the average yields as high as good clones. To remain on the safe side we should add: in the earlier tapping years. The figures for the seedlings refer, for most of the plots, until the 4th tapping year (included), only for one until the 5th, while for the budgrafts in the table they go further, recording yields up to the 13th year of life, i.e. the 9th tapping year. Another remark may be made: the clones used for the comparison are surpassed by better ones now on the market.

At the bottom of the table is shown the average yield figures per tree for a plot with a mixture of buddings and seedlings of Avros 49; the latter are due

to self-fertilization or to pollination with AV. 33. Originally alternating rows of germinated seed and budded stumps, 410 trees per ha (164 per acre) were planted. The number was reduced by selective thinning out whereby many more seedlings were removed, so that since the 8th year of life the number of seedlings has been 30% of the remainder.

In the beginning the average individual yield of the buddings was more than that of the seedlings, but later on the seedlings surpassed the buddings. This is made clear by the relative figures.

TABLE V

Comparison of buddings and seedlings of AV. 49

	Average yield per tree in kg			
	8th	9th	12th	13th year of life
Avros 49, buddings	4,8	5,2	7,2	7,4
Avros 49, seedlings	3,6	4,1	7,7	8,6

Apparently the greater variability of the seedlings and their more severe thinning out tends to increase their yield above the yields of the buddings. It is a curious case showing how with clonal families a severe thinning out is of essential importance and may bring their yield up to a level above that for buddings of the same kind. It may be that this is a special case, for among the seedlings there may have been a certain percentage of self pollinated plants and it is well known that with AV. 49 these are handicapped in growth and yield, so that there the thinning out may have been particularly effective as it removed especially these handicapped plants. On the other hand the experiment shows that the increase in yield with age is quite satisfactory for the seedlings and not behind the increase with buddings.

4. Yields with early tests

TABLE VI

Yield with Hamaker tapping test with seedlings and budgrafts of Tjir. 1

	Plot 1	Plot 2	Plot 12	Plot 13	Plot 22	Plot 23
	Seedl.	Budd.	Seedl.	Budd.	Seedl.	Budd.
Coeff. o. var.	..48,5%	37,0%	50,0%	26,0%	43,7%	35,6%
Missing	.. 2	4	1	—	—	1
Not yet tappable	18	30	9	12	21	30
0— 10 gms	.. 3	—	8	—	4	—
11— 20 gms	..18	9	53	11	33	26
21— 30 gms	..18	14	33	64	37	29
31— 40 gms	..19	14	17	30	14	26
41— 50 gms	..25	24	3	7	8	7
51— 60 gms	..10	9	1	—	2	—
61— 70 gms	.. 6	6	—	—		
71— 80 gms	.. 2	—	1	—		
81— 90 gms	..—	—				
91—100 gms	..—	—				
101—110 gms	.. 1	—				

Table VI allows a good comparison between plantings of a clone and a clonal seedling family of the same clone, Tjir. 1. There are six plots, three of each kind of material. The experiment was planned by the West Java Experiment Station and laid out on a rubber estate in West Java. The seeds were taken from a monoclonal planting and may therefore be considered as self-pollinated. When the stems reached the proper size the trees were submitted to the Hamaker test, an early test tapping system developed in Java by the well known Java planter C. M. Hamaker about 1915 - 1917 (See for description, Hamaker 1917, P. 147). The system is the earliest attempt in this direction and the prototype of further early test tapping system. It was followed by a similar system, applied on young budgrafts of newly developed clones on the H. A. P. M. in Sumatra. From 1921 onwards special test plots of a large number of (untested Cr.) clones were laid out. It was found that preliminary indications as to yielding power of clones could be obtained by tapping them to the wood on half the circumference at $2\frac{1}{2}$-3 years old. The best clones thus selected gave 3-4 gms per tapping at $2\frac{1}{2}$ years old and tapped to normal depth at $3\frac{1}{2}$ years old 7-10 gms per tapping, 15-20gms at $4\frac{1}{2}$ years, equivalent to about $6\frac{1}{2}$ lbs per tree per year (Grantham, 1927). About the same time an improved system of early tapping was conceived by Heusser (1921).

Hamaker and Grantham made incisions in the bark to the wood during a short period on young, $2\frac{1}{2}$ year old trees; Heusser made, with slightly older trees, normal tapping cuts in the bark at normal depth. The Morris-Mann tap is the practical application of the latter system on young trees; in my opinion it is at present the best of the early test tapping systems, but perhaps the last word has not yet been said on this question. The essential difference between the Hamaker and the Morris-Mann test is, that in the first the yield is obtained by a series of incisions into the bark, whilst with the Morris-Mann test the yield is produced by the usual tapping system by excision. Both constitute a fair method of arriving at an estimate for the yield of an individual tree.

For sake of completeness I may mention here the "Testatex" tapping of one year old trees as described by Cramer (1938) and studied by Dijkman and Ostendorf (1941).

When the figures in Table VI are studied it is seen that at the moment the test was applied a small number of plants in every plot were still too small for submitting to it. It will be noted, that these numbers are higher for the plots with buddings (30, 12 and 30) than with the plots with seedlings (18, 12 and 21). The explanation is simple: seedlings have a more conical stem, than buddings, so that nearer to the ground level, where generally the test tapping is started, the seedling has the proper circumference earlier than the more cylindrical budding. The same difference will be noted in the experiment on Kuala Ketil, where the girth increase of the stem at 20" above ground level is much less with the buddings than with the seedlings. A typical seedling tree tapers from the level of the lateral roots to a height of about 4 feet. The decrease in circumference is rapid over the first foot from ground level, becoming more gradual with increase in height. With buddings the growth of the stem is different. Girth increments on large numbers of seedlings and buddings show that the difference in girth at heights of 20 inches and 40 inches is only 5% in buddings, while in seedlings the mean difference is 15%. The girth of a seedling tree at ground level may be double the girth at 40 inches. (Edgar, Manual, 1937, p. 116 - 117).

A further striking point is, that the individual yields of the seedlings in the plot are much more variable than with the buddings. In the plots with buddings there are no trees giving less than 10 gms and in two plots no trees with

yields above 50 gms. In the first plot only apparently in better soil, the best class gives 61-70 gms. With the seedlings the best trees of the plots reach higher figures; the class of 71-80 gms is represented in two plots and the best plot contains one tree of the class 101-110 gms. One look at table VI shows, that with a clonal family the various yield classes extend over a longer range than with the buddings. If this is true for yield, a character which can be measured, it certainly is also true for resistance against disease and other such secondary characters; only it does not show up so clearly.

The higher variability in yield renders a strong selective thinning out based on yield figures more effective with seedlings than with buddings. The greater variability of seedlings of a tree compared with buddings of the same tree results logically in a closer correlation of yield and girth with budgrafts than with seedlings of the same tree and this was found in a comparison made by van der Hoop (1931), who determined the coefficient of correlation for both kinds of planting material derived from the same mother tree and found for the seedlings a value of 0.403—0.602 and, for the budgrafts of 0.709—0.947, so that his conclusion was, that the correlation between yield and girth of budgrafts of a certain mother tree is much higher than that of the seedlings of the same tree.

Mention must be made here of a case described by d'Angremond (1935), in which the illegitimate clonal seedling family of 40 trees of Avros 282 showed a variation in yield, which with removal of the 50% poorest yielders would produce the same increase in the average yield as with a monoclonal planting of AV. 49. However, generally speaking the number of poor yielders will be higher in clonal seedling families than in monoclonal plantings, while the number of good and very good yielders is also higher. In table VI the two lowest classes count with the seedlings 3 plus 18, 8 plus 53 and 4 plus 33 trees, whilst with the buddings they are only 9, 11 and 26. For the various plots the total yield for the 50% poorest trees can be compared with that of the 50% best yielders; it is found then, that the difference between these totals for the seedlings is much larger, than for the buddings, with their more evenly distributed individual yields.

TABLE VII

	Plot 1	Plot 2	Plot 12	Plot 13	Plot 22	Plot 23
	Seedl.	Budd.	Seedl.	Budd.	Seedl.	Budd.
Total yield of 50% poorest trees ..	31.0%	39.6%	25.5%	36.0%	31.3%	37.4%
Of 50% best yielders	69.0%	60.4%	74.5%	64.0%	68.7%	62.6%
Average yield in grams ..	36.4	33.9	24.6	26.5	21.7	28.0

The figures show, that for adjacent plots the yields are of the same level; sometimes the buddings give a higher average (plots 12 and 23), sometimes the seedlings (plot 1). With every pair of plots the total yield of the 50% poorest trees is lower with the seedlings, than with the buddings. As we will see further on, this point is of importance, as it shows, that generally speaking the seedlings, by their greater variability, will profit more from a drastic selective thinning, for instance of 50%, than the buddings.

5. Seedlings and Clones compared on Kuala Ketil

In the Kuala Ketil experiment 6 kinds of PB material are compared. The whole experiment comprises 162 acres and was laid out late in 1933. Each kind of material is represented by 6 plots of 4, 5 acres, and the following kinds are present:

(1) Buddings, planted as budded stumps, of PB 86, PB 183 and PB 186.
(2) Open pollinated seeds of good commercial plantings.
(3) Open pollinated seeds of plantings on Prang Besar Estate.
(4) Seeds from Isolated plot C.
(5) Seeds from Isolated plot D.
(6) Seeds from Isolated plot E.

All the seeds were planted as basket plants simultaneously with the budded stumps.

Since 1937 the planting has been submitted to test-tappings. The standard of tappability was 12″ girth at 20″ height. The cut was opened at 15″ above ground level for the seedlings and 25″ above the union for the buddings.

TABLE VIII

COMPARISON OF BUDDINGS AND SEEDLINGS ON KUALA KETIL

(Data from Prang Besar October Circulars)

PLANTED LATE 1933—1934 FIRST YEAR OF LIFE

	Buddings	Common seed	Seed from Prang Besar	Seed from Plot C	Seed from Plot D	Seed from Plot E
Total stand 1937 ..	4,682	5,048	4,976	5,152	5,230	5,088
do 1939 ..	4,248	4,412	4,393	4,918	4,425	4,415
% trees tapped 1937	36%	61%	79%	81%	77%	82%
Girth Increase 1938	37″	5.0″	4.7″	4.7″	4.6″	4.8″
%trees tapped ..	39%	66%	85%	87%	86%	88%
Girth Increase 1939	2.9″	5.4″	5.2″	5.0″	4.9″	5.2″
%trees tapped 1939	39%	67%	86%	88%	87%	90%
Yield per tree in g. 5 test-tappings in 1937	16.93	5.89	12.39	19.58	20.63	20.63
1938	65.71	26.94	46.18	67.73	68.34	79.70
1939	100.93	49.90	75.60	106.60	106.97	120.20
Yield in lbs. p. acre w. com. tapp. '39 July ..	44.44	28.67	50.89	89.33	90.77	100.88
Aug.	31.67	29.22	45.11	75.11	74.89	80.67

When the Morris-Mann test was first applied, the buddings were only 36% tappable, the seedlings 61%—82%. The percentage figures for 1938 and 1939 are recorded in the table; they are slightly higher. In 1939 commercial tapping was started on 1/3 of the area, (54 acres), for purpose of assessment. The yield figures noted in the table for 1937, 1938 and 1939 are recorded in the circular as "average yield per tree (5 tappings) 1938 test in grammes" and "1939 test" (from circular 1939); the figure for 1937 is taken from 1937 circular. The yields with the commercial tapping, when in all plots 100% of the trees were tappable (except with the buddings, where 98% were tappable) are added at the bottom of the table. They clearly show the high level on which commercial tapping started with the clonal seedlings, compared to the figures for buddings, ordinary and Prang Besar seedlings.

The increase in girth for 1938 and 1939 is also mentioned in the table. For buddings it is in both years 3.7″ and 2.9″, so considerably lower than for the seedlings, where the figure oscillates around 5″. This faster growth with the seedlings explain why the percentage of tappable trees is much higher with this material.

This certainly is an advantage with the clonal families, as it means that the planting can be brought into tapping earlier, perhaps a year earlier, than with buddings. This advantage is not limited to the first tapping year, but extends over a number of years. When the number of trees is considered sufficient to start tapping, when 75% of them have reached the suitable size with the seedlings, there will still be too low a number with the buddings and a fair number will only be brought into tapping the next year, and will remain in yield behind those tapped already. An acre tapped for a year already will be more productive than an acre just brought into tapping, even of the same clone. A remark of Murray (1940) may be cited here as it gives clear data against the vague belief still met sometimes in planting and financial circles that the longer the trees can be left to mature without disturbance by tapping the better will be their performance in the long run. A comparison has been made at Nivitigalakele of the Ceylon Research Institute between trees of eight clones which were brought into tapping at an age of 6 years and an average girth of 19.5 inches, and an approximately similar number of trees of the same clones which were not tapped until they were nearly 8 years old and had a girth of 26 inches. During the two years in which the first group was tapped the difference in mean girth increase between the two groups was less than 4% in favour of the untapped trees. When the yield records of these two groups were studied it was found that the second group gave in its 8th year of age and 1st year of tapping approximately the same average yield per tree as the first group in its 7th year of age and 2nd tapping year. It seems clear that budded rubber trees have to be "educated" to a yield response and that, other things being equal, a tree which has been tapped previously, will give a higher yield than one which has not.

In the Kuala Ketil experiment the test tapping in the subsequent years is done only on trees opened at the first test and the figures are average yields per tree. When every year all tappable trees were taken in with the tapped ones, the yield per acre would have progressed much quicker, as not only the yield per tree but also the number of tapped trees per acre would have been materially increased. The figure per acre for the plots with buddings might have remained then on the same level with the figure for the seedlings in the plots C, D and E. The advantage for the seedlings in the experiment is slightly exaggerated as the buddings were opened at 10″ higher up the stem. However the influence of this factor will be only small.

From the Kuala Ketil experiment the conclusion may be drawn, that generally speaking (a) plantings of good clonal seedling families may give acre yields of the same level as good clonal plantings, (b) such seedling plantings will come earlier into tapping than plantings of budgrafts established at the same time.

6. Selective thinning out

The great variability of clonal seedling families makes the thinning of the planting of primary importance for improving the yield and other characters of the trees. The subject therefore requires full discussion here. A good deal has been written about selective thinning but very few concrete facts are known since Tengwall in 1933 published a first set of figures on the problem,

One of the latest contributions is an article by Ir Van Schoonneveldt published a few years ago in Java (Schoonneveldt, 1948) which gives a good review of the aims and the carrying out of the thinning. It came in good time as on many estates in Indonesia the political situation prevented the work being done when it was required.

Tengwall composed the following table, from statistical material collected from estates for the optimal number of trees per ha at different ages:

TABLE IX

Age Class	Optim. numb. of trees per ha	Average opt. numb. per ha	Average opt. numb. per acre
5— 8 years ..	251—280	265	106
9—12 years ..	251—280	265	106
13—16 years ..	221—250	235	94
17—20 years ..	191—220	205	82
21—29 years ..	161—190	175	70

Tengwall's figures relate to the old plantings of ordinary seedlings and the thinning of plantings just before or after commercial tapping is started. In the following we have clonal seedlings especially in view. With these the technique is somewhat different from that with ordinary seedlings, which are now no longer used, and from that with buddings, which form a high yielding, much more uniform material with which the thinning out is simpler work. With clonal seedlings the improvement of the material should be started much earlier by the grading of the young plants. When they are raised in a nursery the test can be carried out before the material is transplanted to the field so that only preselected plants are admitted to the field. For obtaining fair results the plants should be submitted to the test when 2—3 years old and this means a considerable loss in time for they will require about the same number of years in the field for becoming tappable after being planted as young seedlings. put out as germinated seeds. This latter planting material presents other advantages: it is easier to plant and the planting can be completed in a much shorter time, especially if no laborious planting holes are made. Provision should be made for allowing juvenile selection at an age of 2—3 years by establishing several, 3—5 plants per point. The planting should be made as complete as possible by a quick supplying, say 3 weeks after the planting and eventually a round to put out basket plants on the points where the number of plants is too low. If this has been accomplished the planting can be left growing 2—3 years without any fear of damage from the dense stand per point: I have seen splendid growth of two year old plants put out four per hole and in nurseries, 3 years old and more, where growth was retarded but very few plants had fallen out and which could still be used very well for laying out new fields. The plants, standing in groups of 3—5 per point, can after 2—3 years be submitted to a grading and thinning in the same way as plants in a nursery, with the same effect: the planting will be composed of 2—3 year old plants improved by juvenile selection but in this case there is no interruption in the growth of the plants and their coming into tapping will not be postponed as will be the case with nursery plants which have to be cut back before being transplanted.

The first tree thinning is applied about the time the trees become tappable. In view of the intended policy for this selective thinning out, the density of the

planting and the distribution of the trees in the field (square, quincunx or row planting) should be chosen. Even after the grading of the young plants a further selection of the trees and removal of the undesirable ones (backward trees, trees damaged by pink disease or windbreak) may considerably improve the quality of the planting. It can be divided in a first reduction in number of the nearly tappable trees and subsequent gradual thinning during the commercial tapping when only occasionally one or a few trees will be removed; some will be also lost in the course of the year by natural causes. When the original number of points at planting out was say 180 trees per acre, the number kept at the moment of starting commercial tapping should be 75% of it, say 130 per acre. This is much more than in Tengwall's table but I think those figures rather on the low side, especially when we compare them with those of actual plantings.

In the Kuala Ketil-experiment the original number was probably 180 trees per acre; when commercial tapping was started in the 6th year of life the monthly yields indicate a crop of over a thousand lbs. per acre and the number tapped then must have been over 160 trees per acre. Some other data relate to an experimental planting on an estate near Port Swettenham. 10½ acres were planted with clonal seedlings in November-December 1931; dense planting 12″ × 18″, 207 trees per acre. Seeds taken from the older Avros clones and estate clones; plants graded by a testatex test.

TABLE X

Estate at Port Swettenham. Nov. Dec. 1931. 12″×10″ 207 trees per acre.

Year	Area Acres	Stand per acre trees		Tapping System	Lbs. per acre per annum	Remarks
		Total	In tapping			
1936 ..	3½	164	130	S/2, d/2, 100%	700	——
1937 ..	10½	147	114	S/2, d/2, 100%	553	——
1938 ..	10½	127	115	S/2, d/3, 67%	724	——
1939 ..	10½	126	113	S/2, d/3, 67%	757	11 months
1940 ..	10½	125	122	S/2, d/3, 67%	1,019	11 months

Morris-Mann tests were carried out in December 1934 and June 1935. Trees measuring 12″ and over at 12″ from the collar were taken in for the above tests. On 1st April 1936 3½ acres were brought into commercial tapping on S/2, d/2, 100%. On 1st April 1937 the balance of 7 acres was also brought in.

July 1937 the whole area of 10½ acres was opened on a new cut at 202 on opposite panel. On 1st April 1938 the tapping system was changed to s/2, d/3, 67%. In April 1940 a new cut was opened at 30″ on the original panel.

Since bringing into tapping many trees have been removed for brown bast. Thinning was carried out again in 1941 ; the stand per acre was then 110, with 107 in tapping:

For several years before the beginning of the war planters and the experiment station in the Eastern part of Java have started to lay out fields with row plantings, in which the trees were put out in one direction at a short distance

in the other at a large distance, for instance 1×10 m (equivalent to 33 feet by 33 feet). I have seen in 1940 several fields established in this way, also with rows somewhat nearer to each other, 8 m (about 26.5 feet). Some were already in tapping. The results are very favourable and one of the advantages was that a large number of trees could be placed per ha (with 1×10 m one thousand, or 400 per acre) with $1 \times$ 9m 1,100. We have laid out in 1947 a similar experiment, but instead of putting one plant per point three were planted at 1′ 4″, in small rows square to the main row ; these sets will be reduced a couple of years after the planting and only this one plant kept.

The old conception of the advantage of row planting may be formulated as follows :—The dense rows are at such a large distance that it takes many years before the rows touch each other, so that the thinning can be postponed several years after the coming into bearing of the first trees, especially when the tapping is started early, as suggested above. With row planting it is easy to make out which trees in a row should be removed as several can be examined and compared at a glance. With square planting this is not so easy. I have done it several times in Indo China according to the "systeme des petits carres" (system of the small squares). The number of trees which the planter desires to keep can be reached by judicious removal. When it is judged best for instance to keep say 75% of the original numbers of points the assistant in charge of the thinning walks along alternate rows and stands besides successive alternate trees, so that each time he is at the corner of a fictitious square of 4 points. If each point carries a tree he looks at all four, chooses the poorest one and marks it for the cutting, walks then to the following square, does there the same and so on. If in a square one tree is lacking, the square is left untouched ; when there are only two trees, it is easy to see to what extent leaving all four trees in adjacent squares will fill the gap. When the whole field has been done in this way the field may be once more inspected by a rapid survey and then the marked trees are cut out. A native conductor can be trained for the marking and his work inspected before the cutting takes place. It is sufficient to cut the taproot from the laterals and then the taproot itself under the level of the soil. When this cutting has been done it is curious how little of the effect is seen when one walks through the field ; the piles of the trees stacked at the roadsides may show that quite a number of trees have been removed. With row planting the stand will be generally more complete at the beginning and when it has been calculated how many trees have to be kept, it is easy to mark out of each stretch of say 6 points in the row which one has to be cut, or which when a reduction to 2/3 of the trees is aimed at. From practical experience it may be estimated that with rows such a thinning can be postponed until several years after the first trees have been brought into tapping. This old conception of the possibility of postponing the thinning cannot be maintained in view of the actual results of more recent experiments by van Schoonneveldt, (1951.)

7. Yield and brown bast

The great susceptibility of high yielding clonal seedlings to brown bast has been mentioned several times already; this was also observed in the 40 illegitimate seedlings of AV. 282. In the case of several trees the presence of brown bast has been marked in the registers; for others the tapping has been interrupted for more than a year and the whole course of the yield figures indicates that brown bast was present. A sudden drop in the annual yield from 30 or 40 gms to 10 or 12 gms may be considered as such; sometimes this drop is preceded by a high increase. There are a couple of cases which seem doubtful ; if they are included there are among the 40 trees 16 cases of brown bast, or 40% of the total, a rather high percentage.

Brown bast is now generally considered as a disease caused by some disturbance in the physiology of the tree, not by a fungus or other parasite. Three stages can be distinguished. In the first stage the symptoms comprise a rather sudden excessive flow of latex and long dripping. The best yielding soft bark near the cambium shows a grey to brownish-grey discolouration which can be best observed (like the drying of the cut) by rubbing, a few hours after tapping, the thick and eventually coagulated latex with a little stick away from the tapping cut towards the spout and examining the colour and behaviour of the cut. In a more advanced stage there is no coherent scrap present because the cut is partially dry; at the same time there is a considerable reduction in yield. Finally trees which are seriously affected become entirely dry and the diseased inner bark shows brown stripes and spots. This is the second stage. If left untapped for a time some trees react by forming burrs in the affected bark which may become coherent with the central wood and seriously disfigure the panel (third stage).

The connection of brown bast with yield has been well described in Edgar's Manual 1937. Frequently, high yielders are also late dripping trees, and produce rather dilute latex. Such trees often show signs of brown bast, and probably a predisposing cause of this ailment is the ease with which water is drawn to the latex vessels from the surrounding cells. They are more ready to part with latex than to manufacture it ; a situation which can be countered by reducing the demand upon them, either by shortening the cut or reducing the frequency of tapping. Other trees might be capable of regenerating latex more quickly than the frequency of tapping requires, and in this case the latex at each tapping would be too viscous for rapid flow, and loss of potential crop would result. (Manual, 1937, p. 102). We must however not forget, that the latex collected every day by commercial tapping is different from the latex in the untapped latex vessels. (Ferrand, 1941, p. 25 sub 3 and table p. 71), This concentration may vary considerably according to weather conditions but remains just the same a hereditary character of the " line ". Generally speaking the plants with which the concentration varies least with weather conditions will develop in future in the most robust trees, and less susceptible to drought (Ferrand, 1938). Brown bast, a necrosis of the tissues, occurs when the latter can no longer endure the repeated tappings. Tapping withdraws from the bark of a large quantity of water and if the tissues cannot replace this water by sufficient absorption they dry up and die: Young trees when tapped are more sensitive to brown bast than old trees and tapping withdraws a larger proportion of water from the former. With budgrafts of AV. 49 the concentration of the latex obtained by tapping was 70% of the concentration of the latex in situ; whilst with Tjir. 1 the proportion was only 59%. It is known that AV. 49 is much more resistant to brown bast than Tjir 1 (Ferrand, 1941, p. 28-29).

The investigations of Ferrand are cited here because they show that brown bast resistance may be an individual character connected with latex concentration. It is often said that high yielding material is particularly subject to the disease and it is certainly true that high yielding clonal families and clones often show a high frequency of brown bast cases, but when individual seedlings or clones are compared, exceptions may be found. Reference is made to table V in d'Angremond's article (1935), where individual yields of high yielding trees during 5-13 years are recorded. There many high yielders (for instance AV. 275-283) do not show brown bast compared with other trees in the same production class, (40-50 gms AV. per tapping e.g. AV. 274 and AV. 284). Trees such as AV. 332 (average 89, 5 gm. of dry rubber per tapping). AV. 333 (AV. 90, 5 gms) and AV. 352 (96, 6 gm.) give much higher yields and do not show brown bast.

Large variations in susceptibility to brown bast are found, when clonal families are compared. Schmole published a few figures about the clonal families tested on Polonia (Schmole, 1940). Classified according to the percentage of brown bast in the plantings in 1939, the 8th or 9th year of their life, the following results are found:

TABLE XI

Percentage of brown bast in clonal seedling families:

Origin of Family	Percentage of brown bast	Yield in kg in 5th—9th year
AV. 49×33 and/or ×49 ..	0%	1, 8—6, 4
AV. 308 ill. ..	2%	1, 9—6, 2
AV. 157 ill. ..	3%	1, 5—6, 1
AV. 33 ill. ..	3%	2, 1—5, 3
AV. 185 ill. ..	4%	1, 7—7, 3
AV. 152 ill. ..	5%	1, 6—6, 2
AV. 36×36 ..	9%	2, 0—7, 0
AV. 163 ill. ..	12%	2, 1—6, 5

As will be seen from the figures there is no correlation between yield and percentage of brown bast, the families with 0—2% at the top of the table yielding about the same as those at the bottom, AV. 163 with 2, 1—6, 5, where brown bast is the most frequent (12%). Another curious fact is, that in a comparative test of clones in Malaya AV. 33 and AV. 49 show about 2% of brown bast as a clone, whilst with AV. 163 no cases have been yet observed (till 9th year of life). The difficulty in the comparison of the clonal families is of course, that nothing is known of the male parent.

In some legitimate clonal families a distinct influence of one of the parents on the susceptibility to brown bast is seen.

TABLE XI (*a*)

CLONAL SEEDLINGS COMPARED WITH BUDGRAFTS

AV. YIELDS PER TREE PER YEAR IN KG.

(SEEDL. 7×7 M, 204 HA, BUDGRAFTS 6, 25 × 6, 25 M, 256 HA)

Clon. family	Number	6th year	7th year	8th year	Brown bast	Clone	Number	6th year	7th year	8th year	Brown bast
BD 10 illeg. ..	59	1.05	3.30	3.89	12%	A.V. 183 ..	14	0.62	4.19	4.21	5%
						AV. 185 ..	17	0.72	2.46	4.08	18%
BD 5×2 ..	93	1.70	3.63	3.80	43%	TR. 1 ..	18	1.43	3.25	3.97	6%
						DJ. 1 ..	13	0.37	2.83	3.65	15%
BD 5 ill. ..	57	1.03	3.14	3.69	12%	AV. 214 ..	15	0.37	2.51	3.47	0
						BD. 10 ..	60	1.05	2.44	2.97	25%
BD 5×10 ..	53	1.10	3.21	3.68	17%	TR. 16 ..	18	1.26	2.38	2.81	11%
						Bod. 24 ..	38	0.54	1.73	2.43	8%
BD 10×2 ..	9	1.46	2.74	3.05	55%	BD. 5 ..	159	0.49	1.76	2.40	8%
						TT. 9 ..	14	0.42	2.97	4.64	14%
						TT. 14 ..	17	0.45	3.58	3.94	12%

TABLE XII

FREQUENCY OF BROWN BAST IN LEGITIMATE CLONAL FAMILIES

	Pl. in	Numb. o. tr. pl.	Av. No. tapping months missed per tree per year					Number of trees removed for			Prod. 10th year in kg
			1	2	3	4	5	Disease	Lightn-ing	Wind-break	
Tjir II × Tjir III ..	1929	24	—	0, 09	1, 30	2, 50	0, 27	—	1	—	4, 18
Tjir II × Tjir VIII ..	1929	19	—	—	1, 60	1, 77	1, 00	1	1	—	5, 53
Tjir VIII × Tjir II ..	1929	1	5	—	—	—	—	—	—	—	9, 40
Tjir VIII × PLT 4 ..	1929	15	—	—	0, 60	1, 20	—	—	—	—	5, 99
Tjir VIII × Tjir X ..	1929	22	1, 25	1, 00	1, 11	0, 63	0, 32	1	—	2	5, 75
Tjir X × Tjir II ..	1929	17	—	—	2, 06	1, 44	1, 00	1	—	—	4, 94
Tjir X × Tjir III ..	1929	92	0, 03	0, 37	2, 51	2, 08	1, 18	—	—	—	4, 28
BR 2 × PR 106 ..	1929	19	—	0, 26	0, 44	2, 00	0, 44	1	—	—	6, 29
BR 2 × PR 107 ..	1930	76	—	0, 34	0, 68	1, 21	0, 61	2	2	—	4, 22
PR 107 × BR 2 ..	1930	13	0, 25	—	—	0, 42	0, 42	—	—	—	4, 78
BR illeg. ..	1930	58	0, 14	0, 19	0, 78	1, 05	0, 51	—	—	—	3, 76
PR 126 ill. ..	1930	97	—	0, 22	0, 81	1, 55	0, 54	2	—	—	2, 72

In a study of several legitimate clonal families Dijkman and Ostendorf collected data on the frequency of brown bast. They calculated for these families of how many tapping months per year had been missed per tree on the average by brown bast and in addition the number of trees removed for brown bast. One family (Tjir VIII × PLT 4) shows by far the lowest susceptibility; another family (Tjir X × Tjir III) the highest number; the average for unproductive months is more than treble the figure for the first cited family; the other families are intermediate between these extremes; the families descending from BR 2, principally crossed with LCB 510, show a "moderate" susceptibility. Out of 76 plus 13 there are 89 trees of BR 2 × LCB 510 and reciprocal cross, 2 trees have been removed, or 2, 2% (Dijkman and Ostendorf, p. 441) and Table V, p. 460, reproduced here as Table XII.

As may be seen from the first half of the table there are 3 legitimate crosses among the seedling families. Two of these had BD 2 as pollen parents and show a high percentage of brown bast, indicating that BD 2 has a bad effect in this respect on the crosses. Among the clones AV 185, DJ I and BD 10 are rather susceptible to brown bast.

8. Brown bast and tapping system

The same variations in susceptibility to brown bast as found in comparing clonal families are found when individual trees of a family are compared. In table II 40 trees of the illegitimate clonal offspring of AV 282 are classified according to the individual yield in the 16th year of life. When the course of the variations in annual yield during the first 14 years of life are studied for each tree, some trees are found, which had to be rested for several years for brown bast, others where brown bast forced abstention from tapping for a year or so, still others where after a rest, tapping was resumed but afterwards brown bast came back again or at least a sudden high increase in yield was a nearly certain premonition of its coming back. Other trees are fairly regular good yielders ; there are also a few which remain throughout their whole life at a low level. When the distribution of presumed brown bast trees is studied it is found that they are almost evenly distributed through the 4 yield groups which shows how this factor is nearly evenly felt throughout the whole number of trees.

TABLE XIII

BROWN BAST TREES, 16 TREES TOTAL

Group I	Group II	Group III	Group IV
Tree No. 3	Tree No. 11	Tree No. 22	Tree No. 33
6	16	23	34
7	17	25	35
10	18	28	
	20		
—	—	—	—
4	5	4	3

In the two last groups of trees a certain number is found which were not yet tappable in the 5th year, a factor which of course reduces the average for the whole group and even in the sixth year the average is still lower, but then the yield becomes about the same for those, where tapping was started in the 6th as of those tapped already in the 5th year. (All are in the 3rd and 4th groups.)

TABLE XIV

INDIV. YIELD PER TAPP. PER TREE IN 5TH—8TH YEAR OF LIEE

Not tapped in 5th year					Tapped in 5th year				
TREE	5th year	6th year	7th year	8th year	TREE	5th year	6th year	7th year	8th year
28	n.t.	17, 4	25, 1	28, 2	23	12, 5	20, 3	30, 7	29, 2
29	n.t.	14, 6	33, 2	29, 9	24	7, 5	19, 8	29, 0	32, 1
30	n.t.	14, 4	27, 5	40, 3	25	10, 9	19, 3	22, 3	20, 1
31	n.t.	14, 2	20, 8	23, 8	26	11, 2	18, 3	25, 8	25, 1
33	n.t.	12, 2	25, 3	22, 3	27	6, 6	17, 8	30, 2	31, 4
34	n.t.	11, 1	22, 8	26, 2	32	8, 9	13, 4	16, 3	19, 6
36	n.t.	10, 5	18, 2	16, 6	35	5, 6	11, 1	8, 4	13, 0
37	n.t.	9, 8	13, 5	28, 8	38	11, 0	9, 7	29, 5	30, 7
40	n.t.	9, 1	21, 5	18, 8	39	8, 2	9, 3	16, 7	17, 1
Total	n.t.	113, 3	207, 9	234, 9	Total	82, 4	139, 0	208, 9	218, 3
Av. p. tree	n.t.	12, 59	23, 10	26, 10	Av. p. tree	9, 16	15, 44	23, 21	24, 26

In the later years, for instance 10th—14th year of life, both groups still remain under the figure for first and second group.

TABLE XV

AVER. YIELD P. TAPPING P. TREE IN WHOLE AND LAST PERIOD

Group	For years of life 5—14	For years of life 10—14
I ..	44,34	56,89
II ..	39,71	46,46
III ..	32,02	45,95
IV ..	27,78	39,58

As stated above, in the small group of regularly low yielding trees (35 and 36) this low yield is apparently a genotypical character.

It is not possible to estimate exactly what the influence of brown bast on the productivity of the whole family is and how far other factors (slow growth, genotypical influences) are responsible.

A very interesting view on the whole problem is the conception of van Baalen, a South Sumatra planter, who started a fair sized experiment in 1925 on the influence of 5 tapping systems comprising the following:

TABLE XVI

TAPPING SYSTEMS, VAN BAALEN'S EXPERIMENT

I ..	S/2, d/2,	100%
II ..	S/3, d/2,	67%
III ..	S/2, d/3,	67%
IV ..	S/2, $\frac{20d}{40}$,	100%
V ..	S/3, $\frac{30d}{60}$,	67%

Not only the influence of the tapping system on the yield was studied, but also a good deal of attention was paid to the frequency of brown bast. In one of his first reports (1931) van Baalen expressed his conviction, that the potential yield was mainly dominated by this factor. Trees for which a tapping system of say S/2, d/2, 100%, was too drastic and developed brown bast, should be tapped with a lighter system. If in view of frequent cases of brown bast all trees were tapped uniformly with a lighter system a certain number might not be enabled to develop their full producing capacity. The tapping system should be adapted individually to the tree. We may say that it should be intense enough to get all the latex out of the tree just to the limit, so that by getting more out brown bast would be developed by the tree and reduce its yield. As susceptibility to brown bast is an individual character, so the tapping system should be individual.

Van Baalen explained fully (1931) how he arrived at this result by reducing the tapping cut by 50% as soon as brown bast symptoms were shown by a tree so from S/2 to S/4 or from S/3 to S/6 circumference. If, after having been tapped with such a shortened cut for more than a year, a tree no longer showed brown bast symptoms the cut of S/4 was extended again to S/3 and on a tree where the cut had been reduced from S/3 to S/6 the length of S/3 was used again when a new panel was opened. A striking fact was that trees tapped with S/3 showed a lower percentage of brown bast than those under the other systems.

TABLE XVII

BROWN BAST WITH VARIOUS TAPPING SYSTEMS (VAN BAALEN, 1931)

	Trees with orig. cut	Trees with short d. cut	Trees with re-lengthened cut	Trees dry	Total trees
I. S/2, d/2, 100% ..	290	131	202	—	623
II. S/3, d/2, 67% ..	583	48	—	1	632
III. S/2, d/3, 67% ..	417	79	114	1	611
IV. S/2, d/1, $\frac{20d}{40}$, 100% ..	264	155	187	2	608
V. S/3, d/1, $\frac{30d}{60}$, 67% ..	612	28	—	1	641

In the plots tapped with S/3 the brown bast percentage was 8% (II) and 5% (V) whilst in the others the figures were with I 32% (S/3) and 21% (S/4) with III 12, 9% (S/4) and 18, 7% (S/3) and with V 31% (S/3) and 25% (S/4). The high percentages for I, III and IV are not alarming, as the applied shortening keeps the disease in check and the trees still give good yields. For the period 1926—1931 the figures were: for the sensitive trees with a shortened cut 43, 08 g. of latex, for the healthy trees 46, 9 g. of latex.

In a later report (1935) van Baalen described some modifications in the treatment ; from 1931 the tapping cut, once at S/3, was no longer shortened while when shortened from S/2 to S/4 the new panel was opened again at S/2 when both S/4 panels had been finished. From the figures reproduced here in table XVIII he concluded the treatment applied on the brown bast trees since 1931 showed clearly its influence. The percentage tapped with a reduced cut had become considerably lower, but the percentage of dry trees, negligible in 1931,

had increased ; with the thinning at the end of 1934—beginning 1935 a number of dry trees would have to be cut out as "further unfit." The last report on the experiment was written by Dr. Heubel and published in 1940. In this report the author states that most of the brown bast occurred in the plots, giving the largest quantities of rubber. In the experiment as soon as a tree begins to show "late dripping" the tapping cut is shortened to half length. In the plots tapped with S/3 this shortening was not applied after 1931, but was resumed in 1938.

TABLE XVIII

% OF BROWN BAST WITH VARIOUS TAPPING SYSTEMS

Tapping system	Shortened cut in %				Run dry in %			
	1931	1934	1938	1940	1931	1934	1938	1940
I. S/2, d/2, 100%	53,4	11,1	23,0	10,4	—	3,9	6,4	3,7
II. S/3, d/2, 67%	7,6	—	16,4	0,4	—	2,1	5,4	2,5
III. S/2, d/3, 67%	31,7	12,4	9,4	2,2	—	1,7	3,3	2,5
IV. S/2, d/1, $\frac{20d}{40}$, 100%	56,5	8,7	22,9	15,6	—	2,1	6,4	4,8
V. S/3, d/1, $\frac{30d}{60}$, 67%	4,5	—	8,4	1,7	—	4,1	5,2	4,1

The advice of the West Java Station in late years (Vollema, 1948) is in agreement with Heubel's conclusion. It is true that a high yield has not the necessary consequence that the trees are especially sensitive to brown bast ; progressive selection on yield increases the chance of keeping sensitive material. Therefore it is necessary to consider also which tapping system should be chosen.

The families of Tjir 1 and Tjir 16 which were taken in tapping in September 1935 with S/2, d/3, 67%, showed in the first years such a frequency of brown bast that towards the end of the 4th tapping year (from July 1939 on) the tapping was reduced to S/3, d/3, 44%. The result was not only a reduction in the percentage of brown bast but the yield remained satisfactory until at the end of the 7th tapping year. The tapping was stopped during the Japanese occupation.

From these observations the conclusion is drawn that some of the modern clones and seedling families recommended for commercial plantings give in their youth their optimum production under less intensive tapping systems and that the application of heavy systems in regard to bark consumption, tapping cost and frequency of brown bast and other bark diseases may be a disadvantage.

As a conclusion of the experience of bringing young seedlings into tapping a conservative tapping system should be applied with an intensity of 67% and in the very beginning the intensity of it can be still reduced to 33% by interposing alternating months of rest between the months of tapping. The earlier the tapping begins, the earlier the trees with a tendency to brown bast can be discovered and appropriate measure can be taken. The greater the density at the beginning of the commercial tapping the better the thinning can be adopted with the object of getting the highest possible crop out of the trees.

The author wishes to thank Ir. J. C. van Schoonneveldt for reading through the manuscript and suggesting corrections, he addresses a word of sincere gratitude to his young colleague for this very valuable assistance in preparing it for the press.

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RUBBER RESEARCH SCHEME (CEYLON)

MINUTES of the 107th meeting of the Rubber Research Board held at the Ceylon Chamber of Commerce, Colombo, at 3-15 p.m. on Thursday, 29th May, 1951.

Present: Dr. H. E. Young, Acting Director (in the Chair); Mr. F. A. Obeyesekera; Mr. R. J. Hartley; Senator C. Wijesinghe; Mr. R. H. Wickremesinghe (Controller of Establishments) representing the Deputy Financial Secretary.

Apologies for non attendance were received from Mr. J. L. D. Peiris, Dr. A. W. R. Joachim, Major Montague Jayewickreme, Mr. D. E. Hettiarachi and Mr. W. A. Paterson.

Mr. W. I. Pieris, Smallholdings Propaganda Officer was present by invitation, when discussing the items on the Agenda relating to the Smallholdings Department.

1. MINUTES:

Confirmation—Draft minutes of the meeting held on 20th March 1951, which had been circulated to members, were signed by the Chairman after inclusion of an amendment.

Latex Centres—It was reported that a latex centre had been opened by smallholders at Dapiligoda near Agalawatta and arrangements had been made to buy the latex from this centre and transport to Dartonfield Factory for manufacturing purposes.

Buded Stumps—It was agreed to sell budded stumps to smallholders at -/25 cts for those who own under 5 acres and -/35 cts for those of 5 to 100 acres.

2. BOARD:

The Chairman reported that :—

(*a*) Mr. D. E. Hettiarachi, J.P., U.M., had been nominated by the L.C.P.A. to act during the absence of Mr. Francis Amarasuriya from Ceylon.

(*b*) Mr. W. A. Paterson had been nominated to represent the Planters' Association of Ceylon during the absence of Mr. F. H. Griffith while on furlough.

(*c*) A letter from Major Montague Jayewickreme was tabled stating that he will be away from the Island till end of September 1951 and asking leave from the Board. Leave was approved and it was agreed that the Minister of Agriculture and Lands be asked to nominate a member to act during Major Jayewickreme's absence from Ceylon.

3. REPORTS AND ACCOUTS:

(*a*) *Investment*—Reported that a sum of Rs. 500,000/- had been placed on Fixed Deposit for 6 months at ½% interest.

(*b*) *Annual Report for* 1950—This was considered and approved.

(*c*) *Revote of balances of* 1950 *capital votes*—Balances of 1950 capital votes amounting to Rs. 31,850/62 were revoted.

(*d*) *Recast Estimates for* 1951—These were approved as there was no change in the total Revenue and Capital Expenditure and also in the Income for 1951.

4. EXPERIMENTAL COMMITTEE:

Recommendations made at meeting held on 15th May 1951 :—

(*a*) *Disposal of rejected articles*—to dispose these articles after a notification to the public by way of advertisements of some kind.

(*b*) *Research Programme*—Botany Department, Chemical Department, and Agronomy Department. These were considered and approved.

5. STAFF:

(*a*) Reported that Dr. E. J. Risdon, Chemist, and Mr. D. H. Constable, Agronomist, had arrived in Ceylon and assumed duties on 28th April and 16th April 1951 respectively.

(*b*) *Junior Staff*—Changes in junior staff since the last meeting were reported.

6. COCOA:

A letter from the P. A. Ceylon suggesting that arrangements be made for cocoa research to be organised as a branch of the R. R. S. was tabled. The Acting Director was requested to inform the P. A. Ceylon that the Research Scheme is exploring the possibilities of making arrangements for cocoa research but in the meantime would the P. A. find out what finance could be made available for such a scheme, as it would, if undertaken, necessitate the appointment of a new officer so that full time attention could be given to the subject.

Sgd. H. E. YOUNG,
Acting Chairman

Dartonfield,
Agalawatta,
16th June, 1951

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES of the 108th meeting of the Rubber Research Board held at the Planters' Association Head Quarters, Colombo, at 2.30 p.m. on Monday 20th August 1951.

Present: Mr. F. H. Griffith (in the Chair), Dr. A. W. R. Joachim (Director of Agriculture), Major T. F. Jayewardene M.P., Mr. R. J. Hartley, Mr. F. A. Obeyesekera, Mr. J. L. D. Peiris, Senator C. Wijesinghe and Dr. H. E. Young (Acting Director).

Mr. R. H. Wickremesinghe (Controller of Establishments) had expressed his inability to attend.

1. MINUTES:

Draft minutes of the meeting held on 29th May 1951, which had been circulated to members, were confirmed and signed by the Chairman.

2. BOARD:

The following changes in membership were reported :

(*a*) Mr. F. H. Griffith had resumed his seat with effect from 10th August relieving Mr. W. A. Paterson who had been acting for him.

(*b*) Major T. F. Jayewardene M.P. had been nominated by the Minister of Agriculture & Lands to act for Major Montague Jayewickreme M.P. with effect from 2nd July.

(*c*) Mr. Francis Amarasuriya had resumed his seat on his return to the island relieving Mr. D. E. Hettiaratchi.

3. EXPERIMENTAL COMMITTEE:

Recommendations of the Committee:

Tenders for buildings—The Committee's recommendations regarding the acceptance of the tenders of a certain contractor for the construction of a staff club house, 2 intermediate staff bungalows, 2 junior staff bungalows and 12 labourers' cottages were approved.

4. DECISION BY CIRCULATION OF PAPERS:

Appointment of Clerk-Librarian—It was reported that members had approved the appointment of a Clerk-Librarian on the proposed salary scale.

5. REPORTS AND ACCOUNTS:

(*a*) *Investments*—The investment of Rs. 500,000/- in the new 3% State Loan was reported.

(*b*) *Statement of Receipts and Payments for the* 1*st Quarter* 1951—was approved.

(*c*) *Purchase of Jeep*—The purchase of a jeep and trailer in accordance with an earlier decision of the Board was reported.

6. CLEARING FOREST LAND HEDIGALLA:

Contracts awarded to two contractors for felling and clearing 75 acres of forest land at Hedigalla for 1952 planting were reported.

7. STAFF:

(*a*) *Director*—The appointment of a Director was considered and left over for final decision at a full meeting of the Board.

(*b*) *Secretary-Accountant*—It was reported that Mr. C. D. de Fonseka, Secretary-Accountant, had resumed duties on 17th August on the expiration of his end-of-contract leave.

(*c*) *Acting Asst. Mycologist*—It was reported that Mr. D. M. Fernando, Acting Asst. Mycologist, had been awarded a two-year scholarship by the Canadian Government under the plan for technical aid to S. E. Asia, and had left Ceylon by air on 27th July.

(*d*) *Junior Staff*—Changes in junior staff since the last meeting were reported.

8. LONDON ADVISORY COMMITTEE:

(*a*) *Report for* 1949 *and* 1950 (*C. P. No.* 1624)—was tabled.

(*b*) *Minutes of the* 51*st and* 52*nd meetings of the Committee and Tech. Sub-Committee*—were tabled.

9. DISTRIBUTION OF BUDWOOD OF CLONE LCB. 1320:

It was reported that the Indonesian Government had appointed the Scheme as its official agents for the distribution of budwood of clone LCB. 1320.

Arrangements had been made for importation of budwood of this clone direct from Java for establishment in the Scheme's nurseries for experimental and distribution purposes.

10. SALE OF BUDWOOD OF R.R.I.M. CLONES TO SMALL HOLDERS:

A request for purchase of budwood of clone R.R.I.M. 501 by a smallholder was reported and it was agreed that budwood of this clone be sold to smallholders at half the usual price *i.e.* Rs. 3/50 per yard subject to signature of the usual sales agreement.

11. MR. CONSTABLE'S SERVICES FOR COCOA INDUSTRY:

A letter from the Planters' Association of Ceylon enquiring whether the services of Mr. Constable, Agronomist, could be made available in an advisory capacity for cocoa planting was considered. It was agreed that Mr. Constable's services could not be spared in an advisory capacity but he may serve on the Dept. of Agriculture committee which deals with cocoa planting.

12. MANURIAL EXPERIMENTS:

Proposed arrangements for laying out manurial trials on estates were approved.

The meeting then terminated.

Sgd. C. D. DE FONSEKA,
Secretary-Accountant

Dartonfield,
Agalawatta,
30th August, 1951

RUBBER RESEARCH SCHEME (CEYLON)

MINUTES of the 109th Meeting of the Rubber Research Board held at the Planters' Association Headquarters, Colombo, at 2-30 p.m. on Monday, 3rd September, 1951.

Present: Mr. F. H. Griffith (in the Chair), Mr. R. J. Hartley, Dr. A. W. R, Joachim (Director of Agriculture), Mr. F. A. Obeyesekera, Mr. J. L. D. Peiris. Senator C. Wijesinghe, Mr. R. H. Wickremesinghe, C.C.S., (Controller of Establishments) and Dr. H. E. Young (Acting Director).

1. MINUTES:

(*a*) *Confirmation*—Draft minutes of the meeting held on 20th August, which has been circulated to members, were signed by the Chairman as correct.

(*b*) *Matters arising from the minutes:*

Director—It was agreed that Dr. H. E. Young D.SC. should be appointed Director, and the terms of the appointment were decided on. Dr. Young was asked to make his recommendations to the Board regarding the continuation of Oidium research and Mycological work.

2. BOARD:

It was reported that Major Montague Jayewickreme, M.P. had resumed his seat on the Board relieving Major T. F. Jayewardene, M.P.

3. STAFF:

Changes in staff since the last meeting were reported.

Sgd. C. D. DE FONSEKA,
Secretary-Accountant

Dartonfield,
Agalawatta,
8-9-51

RUBBER RESEARCH INSTITUTE OF CEYLON

MINUTES of the 110th meeting of the Rubber Research Board held at the Planters' Association Headquarters, Steuart Place, Colombo, at 2-30 p.m. on Monday, 5th November, 1951.

Present: Mr. W. A. Paterson, Mr. Francis Amarasuriya, Major Montague Jayewickreme, M.P., Dr. A. W. R. Joachim (Director of Agriculture), Mr. R. J. Hartley, Mr. F. A. Obeyesekera, Mr. J. L. D. Peiris, Mr. R. H. Wickremesinghe, C.C.S., (Controller of Establishments) and Dr. H. E. Young (Director, R.R.I.)

An apology for absence was received from Senator C. Wijesinghe.

The Vice-Chairman, Dr. H. E. Young, took the chair.

1. BOARD:

Reported that Mr. F. H. Griffith had resigned on his departure from the island on retirement and that Mr. W. A. Paterson had been nominated in his place by the Planters' Association of Ceylon with effect from 8th October 1951.

Mr. Paterson was unanimously elected Chairman of the Board.

2. MINUTES:

Draft minutes of the meeting held on 3rd September, 1951, which had been circulated to members, were confirmed and signed by the Chairman.

3. CHANGE OF NAME:

It was reported that the amending Ordinance (Rubber Research Amendment Act No. 30 of 1951) providing for the name of the institution being changed to Rubber Research Institute of Ceylon with effect from 1st September, 1951, had been passed by Parliament.

4. DECISION BY CIRCULATION OF PAPERS:

Appointment of Mycologist—It was reported that all members had approved the appointment of Ir. J. H. Van Emden as Oidium Research Officer and Mycologist. He had accepted the appointment and was expected to arrive in Ceylon early in December.

5. EXPERIMENTAL COMMITTEE:

Recommendations made at meeting held on 29th September, 1951:

(*a*) *Visiting Agent's Report*—Supplementary votes as recommended by the Committee were passed to provide for extra expenditure to be incurred on weeding and diseases.

(*b*) *Purchase of clonal seed and seedlings*—A supplementary vote of Rs. 5,600/- was passed to cover the cost of clonal seeds and seedlings to be purchased for 1953 planting.

(*c*) *Research Programme for* 1952—The draft research programme for 1952 was approved.

1. *Overseas training for Graduate Research Assistants*—The Director's suggestion for the overseas training of the three Research Assistants who are now in training at Dartonfield were considered and approved.

2. *Smallholdings Dept.*—Matters of policy in regard to the work of the Smallholdings Department were discussed and the extent of its relations with certain Govt. Departments was defined. The Smallholdings Propaganda Officer came into the meeting during the consideration of this item.

Mr. Wickremesinghe left the meeting.

(*d*) *Contracts for labourers' cottages*—Agreed that contracts for the construction of 8 labourers' cottages at Hedigalla and 4 at Dartonfield be awarded to the two contractors who are at present working on these two estates.

The minutes were adopted subject to the above comments.

Mr. J. L. D. Peiris left the meeting.

6. REPORTS AND ACCOUNTS:

(*a*) *Balance Sheet and Auditor General's Report for* 1950—were approved and covering sanction was given for the over-expenditure on the year's votes specified in the Auditor's Report.

(*b*) *Statement of Receipts and Payments for the 2nd Quarter* 1951—was approved.

(*c*) *Estate accounts for 1st and 2nd Quarters* 1951—were tabled.

(*d*) *Draft Estimates for* 1952—Draft estimates for 1952 providing for income and expenditure as follows were approved :

Estimated Income		Rs. 1,610,129
„ Expenditure—		
Revenue	Rs. 959,482	
Capital	„ 321,020	
		„ 1,280,502
Estimated Excess of Income over Expenditure ..		Rs. 329,627

7. STAFF:

(*a*) *Botanist*—Agreed that Mr. C. A. de Silva, Botanist, be re-engaged for a further term of 4 years on the termination of his present contract in February 1952.

(*b*) *Smallholdings Propaganda Officer*—Agreed that Mr. W. I. Pieris, Smallholdings Propaganda Officer, be re-engaged for a further term of 4 years on the termination of his present contract in March 1952.

8. EXCHANGE OF BUDWOOD:

Reported that budwood of certain local and other clones had been sent to the Institut Des Recherches Sur Le Caoutchouc En Indochine, Indochina, in exchange for budwood of some of their clones. Proposed arrangements for the distribution of material of these clones on either side were considered and approved.

9. LONDON ADVISORY COMMITTEE FOR RUBBER RESEARCH (CEYLON AND MALAYA):

(*a*) *Contribution for* 1952—It was agreed that the contribution for 1952 should be the same as for the current year.

(*b*) *Minutes*—Minutes of the 53rd meeting of the Committee and Technical Sub-Committee and the 1st meeting of the Latex sub-committee were tabled.

10. PUBLICATIONS:

The Annual Report for 1950 and Advisory Circular No. 30 were tabled.

Before the meeting ended Mr. Hartley expressed the thanks of the Board to its previous Chairman, Mr. F. H. Griffith, for his valuable services as a member for 21 years and as Chairman since June, 1950.

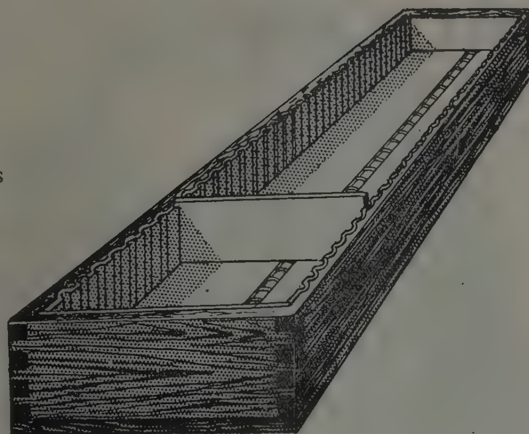
Sgd. C. D. DE FONSEKA,
Secretary-Accountant

Dartonfield,
Agalawatta,
27-11-51

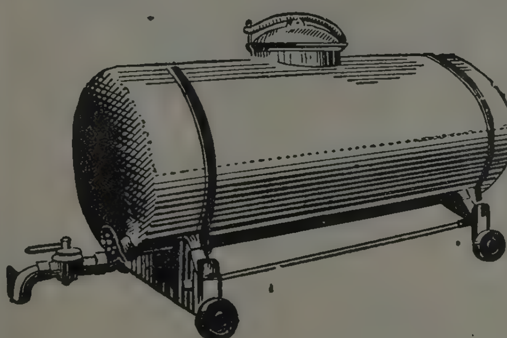
ALUMINIUM COAGULATING AND TRANSPORTATION TANKS

The "Standard" Tank

Aluminium lined with 75 or 90 aluminium partitions



- Clean, uniform sheets
- Minimum of froth sheet
- Saving in factory space
- Saving in time and labour
- Saving in maintenance.



The Aluminium Latex Transportation Tank

- Requires no Upkeep
- Light and easy to handle
- Provides cleanliness in transport
- Made to fit inside the estate lorry.

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Rubber Research Institute of Ceylon

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Clerks (3)	
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Smallholdings Department	
Smallholdings Propaganda Officer	W. I. Pieris, B.A. Hortic. (Cantab.)
Assistant Propaganda Officers	N. W. Palihawadana, K. Wilson de Silva, H. H. Peiris
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Secretary-Accountant ..	C. D. de Fonseka, A.C.C.A., A.C.C.S.
Chief Clerk ..	B. Tillekeratne
Clerks (7) and Clerk-Librarian	

Note—The Laboratories and Head Quarters Offices of the Institute are situated at Dartonfield Estate, Agalawatta. Telephone No. 26 Agalawatta. Telegraphic Address 'Rubrs', Agalawatta. There are two Experimental Stations, one at Nivitigalakele, Matugama, and the other at Hedigalla, Latpandura. The office of the Smallholdings Dept. is at Eastern Bank Buildings, Fort, P. O. Box No. 901, Colombo. Telephone No. 2462, Colombo.